Ministry of Education and Science of Ukraine
Lutsk National Technical University

SCIENTIFIC RESEARCH IN THE FIELD AND INTELLECTUAL PROPERTY

Lecture Notes
for Students of the Second (Master's) Level of Higher Education
in the Field of Knowledge G – Engineering, Manufacturing and Construction,
Specialty G5 – Electronics, Electronic Communications, Instrument Engineering, and Radio Engineering,
Educational Programs «Electronics» and «Telecommunications and Radio Engineering»
for full-time and part-time forms of study

Lutsk – 2026

UDC 62:001.89(07)
F - 97
The electronic copy of the printed edition has been submitted for inclusion in the repository of Lutsk National Technical University
Library Director of the V. Bozhydarnyk: _____ Nataliia POLISHCHUK
Recommended for publication by the Academic Council of the Faculty of Computer and Information Technologies of LNTU, protocol No. __ dated «_____» _____ 2025.

Head of the Academic Council of FCIT: _____ Inna KONDIUS

Reviewed and approved at the meeting of the Department of Electronics and Telecommunications of LNTU, protocol No. _6_ dated «_02_» ____01_____ 2026.

Head of the Department of Electronics and Telecommunications:	_____	Valentyn ZABLOTSKYI, Ph.D. in Engineering, Associate Professor, LNTU
Compiled by:	_____	Mykola KHVYSHCHUN, Ph.D. in Physics and Mathematics, Associate Professor of the Department of Electronics and Telecommunications, LNTU
	_____	Viktor LYSHUK, Ph.D. in Engineering, Associate Professor of the Department of Electronics and Telecommunications, LNTU
Reviewer:	_____	Nataliia LISHCHYNA, Ph.D. in Engineering, Associate Professor, Head of the Department of Software Engineering, LNTU
Responsible Editor:	_____	Valentyn ZABLOTSKYI, Ph.D. in Engineering, Associate Professor, Head of the Department of Electronics and Telecommunications, LNTU

F-97 Scientific Research in the Field and Intellectual Property. Lecture Notes for Students of the Second (Master's) Level of Higher Education in the Field of Knowledge G – Engineering, Manufacturing and Construction, Specialty G5 – Electronics, Electronic Communications, Instrument Engineering, and Radio Engineering, EP «Electronics» and «Telecommunications and Radio Engineering», for all forms of study. Compiled by M. Khvyshchun, V. Lyshchuk. Lutsk: LNTU, 2025. 80 p.

CONTENTS

INTRODUCTION

The rapid development of engineering technologies, the growth of high-tech industries, and the global transition toward an innovation-driven economy determine the increasing importance of scientific research in the professional training of Master's students in Electronics**,** Electronic Communications**,** Instrument Engineering**,** and Radio Engineering. Modern specialists in the G5 specialty are expected not only to apply existing technical solutions but also to generate new knowledge, design competitive engineering products, validate research results using modern methods, and ensure their legal protection and effective implementation.

Scientific research in engineering is a systematic process aimed at obtaining new reliable knowledge, identifying закономірності (regular patterns) of objects and processes, and transforming research outcomes into practical results: devices, systems, technologies, software-hardware solutions, and innovative services. Therefore, the future engineer must master the methodology of research activity: formulation of a scientific problem, selection of adequate methods of theoretical and experimental investigation, collection and processing of scientific information, analysis and interpretation of results, and preparation of research papers according to academic standards.

At the same time, scientific achievements in engineering have tangible economic value and require legal protection. In this context, intellectual property (IP) becomes a key tool for safeguarding the rights of creators, preventing unfair competition, and ensuring commercialization of research results. Knowledge of the legal foundations of intellectual property, patenting procedures, licensing, and technology transfer is essential for engineers who plan to introduce innovations into industry, cooperate with business partners, participate in grant projects, or develop startup solutions.

The purpose of these lecture notes is to form students competencies in planning and conducting scientific research in the engineering field, presenting and defending research outcomes, and managing intellectual property rights to ensure the practical implementation of innovative developments in the electronics and telecommunications sectors.

Topic 1. Science and Its Role in the Development of Society

1.1 The Concept of Science

The concept of science has several basic meanings. First, by science (Greek epistēmē, Latin scientia) we understand a sphere of human activity aimed at producing and systematizing, in theory, objective knowledge of reality. In the second sense, science appears as the result of this activity – that is, a system of acquired scientific knowledge. Third, the term «science» refers to individual branches of scientific knowledge. Fourth, science can be regarded as a sphere of culture that has not existed at all times and among all peoples. In the course of historical development, science has become a productive force of society and one of its most important social institutions.

The immediate goals of science are the acquisition of knowledge about the surrounding world and the prediction of processes and phenomena of reality on the basis of the laws it discovers. In a broad sense, its goal is to reflect on reality. Science is designed to directly reveal the essential aspects of all phenomena of nature, society, and thinking.

The main tasks of science include:

– the discovery of the laws governing the motion of nature, society, thinking, and cognition;

– the collection, analysis, and generalization of facts;

– the systematization of acquired knowledge;

– the explanation of the essence of phenomena and processes;

– the forecasting of events, phenomena, and processes;

– the determination of directions and forms of practical application of acquired knowledge.

Not all knowledge can be regarded as scientific. Knowledge obtained solely through simple observation cannot be considered scientific. Although such knowledge plays an important role in human life, it does not reveal the essence of phenomena or the relationships between them that would allow us to explain why a phenomenon occurs in a particular way and to predict its further development.

The validity of scientific knowledge is determined not only by logic but primarily by its mandatory verification in practice. Scientific knowledge fundamentally differs from

blind faith and from the unquestioning acceptance of certain propositions as true without logical justification and practical verification. By revealing the regular connections of reality, science expresses them in abstract concepts and schemes that strictly correspond to that reality.

Being inseparable from the practical way of mastering the world, science as the production of knowledge represents a specific form of activity, distinct both from material production and from other forms of spiritual activity. In material production, knowledge is used only as an ideal means, whereas in science its acquisition constitutes the main and direct goal, regardless of the form in which this goal is embodied – whether as a theoretical description, a technological process scheme, a set of experimental data, or the formula of a particular substance.

Unlike activities whose results are often known in advance or predetermined before the activity begins, scientific activity is rightfully called such because it produces an increase in new knowledge; that is, its result is fundamentally non-traditional. For this reason, science acts as a force that continuously revolutionizes other types of activity.

Science differs from the aesthetic (artistic) way of mastering reality, represented by art, by its striving for depersonalized, maximally generalized objective knowledge, whereas in art the results of artistic cognition are inseparable from the unique personal element. Art is often characterized as «thinking in images» and science as «thinking in concepts» emphasizing that the former primarily develops the sensory – imagery aspect of human creative ability, while science mainly develops the intellectual – conceptual one.

The development of science has a cumulative character: at each historical stage, it summarizes its past achievements in a concentrated form, and each scientific result becomes an integral part of its overall fund, not being negated by subsequent advances in cognition but only refined and reworked.

The continuity of science leads to a unified line of its progressive development and its irreversible nature. It also ensures the functioning of science as a special kind of «social memory» of humanity, theoretically crystallizing past experience in the cognition of reality and mastery of its laws.

The process of scientific development is expressed not only in the growth of the «sum» of accumulated positive knowledge. It also concerns the entire structure of science. At each historical stage, scientific cognition uses a specific set of cognitive forms – fundamental categories and concepts, methods, principles, and explanatory schemes – collectively referred to as a style of thinking. For example, observation was characteristic of the ancient style of thinking as the main means of acquiring knowledge; modern science relies on experiment and the dominance of an analytical approach that directs thinking toward the search for the simplest, irreducible elements of the studied reality. Contemporary science is characterized by a striving for a holistic and multidimensional coverage of studied objects.

Each established structure of scientific thinking opens the way for extensive development of cognition and its expansion into new spheres of reality. However, the accumulation of new material that cannot be explained within existing schemes necessitates the search for new, intensive paths of scientific development, sometimes leading to scientific revolutions – that is, radical changes in the main components of the content structure of science, and the emergence of new principles of cognition, categories, and methods. The alternation of extensive and revolutionary periods of development, characteristic of science as a whole and of its individual branches, eventually manifests itself in corresponding changes in the forms of organization of science.

Science can be viewed as a system consisting of theory; methodology, methods, and research techniques; and the practice of implementing obtained results. From the perspective of interaction between the subject and object of cognition, science includes the following elements: the object – the aspect of reality studied by a particular science; the subject – the individual scientist, specialist, researcher, or scientific organization; and the scientific activity of subjects who apply specific techniques and methods to reveal the laws of reality.

The development of science proceeds from the collection of facts, their study and systematization, generalization, and the disclosure of individual regularities to a logically coherent system of scientific knowledge that allows explanation of known facts and prediction of new ones.

The path of cognition moves from living contemplation to abstract thinking, and from the latter to practice.

The process of cognition includes the accumulation of facts. Without systematization and generalization, without logical comprehension of facts, no science can exist. However, although facts are necessary material for a scientist, they are not science in themselves. Facts become part of scientific knowledge only when they appear in a systematized and generalized form.

Facts are systematized and generalized through the simplest abstractions – concepts (definitions), which are important structural elements of science.

The highest form of generalization and systematization of knowledge is theory. A theory is understood as a doctrine of generalized experience (practice) that formulates scientific principles and methods allowing the generalization and understanding of existing processes and phenomena, analysis of the influence of various factors on them, and the formulation of recommendations for their practical application [1,2].

1.2 Basic Concepts

Sciences differ by their subject and object of research. The subject of a science is the aspect in which an object is represented within that science. The object of research is the aspect of reality toward which the given science is directed. Each science has its own concepts, tools, and methods.

Natural sciences study the behavior of objects in the surrounding world. Social sciences deal with human behavior and social institutions.

The foundation of science consists of laws – discovered stable relationships between phenomena. A set of laws forms a theory – a systematized description and explanation of phenomena in a particular field. The development of science represents the development and change of theories. A theory exists until facts accumulate that contradict its propositions. The inability to explain new facts within an existing theory gives rise to the need for analysis and the formulation of a new set of hypotheses.

Scientific (research) activity is activity aimed at obtaining and applying new knowledge, including:

– fundamental scientific research – experimental or theoretical activity aimed at acquiring new knowledge about the basic laws governing the structure, functioning, and development of humans, society, and the natural environment;
– applied scientific research – research primarily aimed at applying new knowledge to achieve practical goals and solve specific tasks.

Fundamental sciences explore the world regardless of practical applicability, while applied sciences are oriented toward the application of knowledge obtained through fundamental research. However, fundamental and applied sciences exist only in interrelation; they complement and develop each other. Scientific research aims to identify the properties and characteristics of the studied object and establish its essential features.

Scientific and technical activity is activity aimed at obtaining and applying new knowledge to solve technological, engineering, economic, social, humanitarian, and other problems, and to ensure the functioning of science, technology, and production as a unified system.

Experimental development is activity based on knowledge acquired through scientific research or practical experience and aimed at preserving human life and health, creating new materials, products, processes, devices, services, systems, or methods, and further improving them.

A scientific or scientific – technical result is the product of scientific or scientific technical activity containing new knowledge or solutions, recorded on any information medium.

State scientific and technical policy is a system of goals, directions, methods, and forms of state influence on the acquisition of new scientific results and the creation and adoption of new technologies. The state regards science and its scientific potential as a national asset that determines the future of the country; therefore, supporting the development of science becomes a priority state task.

Scientific and technical policy as an independent sphere of state activity is historically very young. No country yet possesses long-standing traditions and extensive experience in this field repeatedly tested in practice.

1.3 Economic Situation in the Field of Science

With the onset of market transformations in the economy, state funding for science sharply decreased, and demand for its results declined.

To assess the situation, not so much the absolute amount of funds allocated to science is important as their share in the total resources of the country – its gross domestic product (GDP). This indicator reflects the objectively complex balance of the national economy. Such indicators change slowly unless force majeure circumstances arise, such as war or major natural disasters. Even a tenth or a hundredth of a percent is significant due to the magnitude of GDP itself.

In terms of the share of expenditures on research and development, Ukraine lagged behind most G7 countries as early as 1991. Subsequently, the gap widened, clearly indicating serious societal problems and an imbalance of resources.

In 1997, expenditures on funding Ukrainian science amounted to 0.8% of GDP; in 1998 – to 0.6%. In 1998, the state sector of science accounted for 67.5% of all R&D expenditures, the business sector for 27.0%, university research units for 5.4%, and the private non-profit scientific sector for 0.06%. Ukraine's strategic interests would correspond to funding at the level of 2 – 3% of GDP, which is typical for most steadily developing countries. The more a country spends on research and development, the higher its level of economic development and living standards. A weak scientific and technical sector absorbing less than 2% of GDP is characteristic of countries with a raw – material export orientation.

1.4 Typical Funding Models

The following approaches to financing high-technology development can be distinguished:

1. «Frontal» approach – allocating funds across the entire scientific potential in amounts requested by scientists themselves. This approach does not require prioritization or coordination mechanisms among sectors. Once scientists substantiate their demands, government agencies finance them.

2. «Comprehensive» approach – managing scientific and technological progress as an independent socio-economic sector. This approach involves detailed analysis of the country's economic situation, scientific forecasting of its development, and the creation of favorable objective and subjective conditions for directing the process in line with societal interests.

3. «Deficit-based» management – based on the goal of obtaining maximum results from existing scientific potential under limited financial resources. It aims to maintain technological leadership where it exists, restore it where it has been partially lost, and ensure that investments in science yield tangible benefits—not only publications and patents, but also expanded markets, reduced trade deficits, and other material gains.

These funding models can be used independently or in a complementary manner across different scientific fields.

1.5 Scientific and Technical Policy

The main goals of state scientific and technical policy include the development, rational allocation, and effective use of scientific and technical potential; increasing the contribution of science and technology to economic development; addressing key social tasks; ensuring progressive structural transformations in material production; improving efficiency and competitiveness; enhancing environmental conditions and information security; strengthening national defense and security; and reinforcing the link between science and education.

The most important principles of state scientific policy include reliance on national scientific potential; freedom of scientific creativity; integration of science and education; protection of intellectual property rights; development of research organizations of various ownership forms; support for innovation; and enhancement of the prestige of scientific work.

The key long-term task of state scientific, technical, and innovation policy is to determine development priorities and create legal, economic, and financial conditions for activating scientific and innovation activities.

1.6 Priorities of Scientific Research

The main financial instrument of state scientific and technical policy is the state budget. The share of scientific expenditures in the total state budget amounts to 6 – 7% in the USA; 4 – 5% in France, Germany, the United Kingdom, and Italy; and 3% in Japan. R&D expenditure as a share of GDP reaches 2.9% in Japan, 2.8% in the USA, 2.7% in Germany, 2.4% in France, 2.3% in the UK, 1.7% in Italy, and 1.6% in Canada.

Fundamental science and fundamental knowledge form the basis of scientific and technological development. Fundamental knowledge is a core component of human culture and shapes worldview, morality, and spirituality. Therefore, fundamental research in mathematics, natural sciences, humanities, and social sciences constitutes a key state priority.

1.7 Classification of Sciences

Scientific disciplines forming the system of sciences can conventionally be divided into three major groups: natural, social, and technical sciences. There is no strict boundary between these subsystems; some disciplines occupy intermediate positions.

By orientation and relation to practice, sciences are divided into fundamental and applied. Fundamental sciences aim to discover laws governing nature, society, and thinking. Applied sciences focus on using the results of fundamental sciences to solve practical and social problems. Development activities translate applied research results into technologies, materials, and processes.

Fundamental sciences typically outpace applied sciences, providing theoretical groundwork. In modern science, applied research accounts for 80–90% of all research and funding. A pressing challenge today is strengthening systematic links and shortening the cycle «fundamental research – applied research – development – implementation» [1-3].

Topic 2. Scientific Research

2.1 Stages of Scientific Research

The form in which science exists and develops is scientific research. The purpose of scientific research is to define a specific object and to conduct a comprehensive and reliable study of its structure, characteristics, and relationships on the basis of principles and methods of cognition developed in science, as well as to obtain results useful for human activity and introduce them into production with a subsequent effect.

The results of scientific research are evaluated more highly when the conclusions and generalizations are more scientifically grounded, more reliable, and more effective. They should provide a foundation for new scientific developments. One of the most important requirements for scientific research is generalization, which enables establishing dependencies and relationships among the phenomena and processes under study and drawing scientific conclusions. The deeper the conclusions, the higher the scientific level of the research.

Scientific research is divided into fundamental and applied. Fundamental scientific research is understood as an experimental or theoretical activity aimed at acquiring new knowledge of the basic laws governing the structure, functioning, and development of humans, society, and the natural environment. Applied scientific research is defined as research aimed primarily at using new knowledge to achieve practical goals and solve specific tasks.

By source of funding, scientific research is distinguished as: budget-funded, contract-based, and unfunded. Budget-funded research is financed by the Ukrainian state budget. Contract-based research is financed by customer organizations under economic contracts. Unfunded research may be carried out on the initiative of a scientist or as part of a lecturer's individual academic plan.

By duration, scientific research may be divided into long-term, short-term, and express research.

In science, one can distinguish empirical and theoretical levels of research and knowledge organization. The theoretical level of scientific knowledge presupposes the existence of special abstract objects and the theoretical laws that connect them, created for

the purpose of idealized description and explanation of empirical situations – that is, for understanding the essence of phenomena. Their aim is to expand society's knowledge and help to understand the laws of nature more deeply. Such developments are mainly used to advance new theoretical research, which may be long-term, budget-funded, etc.

The elements of empirical knowledge are facts obtained through observation and experiment that record the qualitative and quantitative characteristics of objects and phenomena. Stable repeatability and relationships between empirical characteristics are expressed by empirical laws, which often have a probabilistic character.

The theoretical level of research is characterized by the predominance of logical methods of cognition. At this level, the obtained facts are studied and processed using logical concepts, laws, and other forms of thinking. Here, the objects under study are mentally analyzed and generalized; their essence, internal relationships, and laws of development are comprehended. The structural components of theoretical cognition are problem, hypothesis, and theory.

A problem is understood as a complex theoretical or practical task, the methods of solving which are unknown or only partially known. A hypothesis is an assumption about a cause that requires verification and proof, produces certain consequences, and concerns the structure of the studied objects and the nature of internal and external relationships among structural elements. A hypothesis is scientific only if it is confirmed by facts and can exist only as long as it does not contradict indisputable facts of experience; otherwise, it becomes mere fiction. Thus, a scientific hypothesis must meet the following requirements:

– relevance, i.e., relation to the facts on which it is based;

– testability by experimental means (with exceptions for hypotheses that cannot be tested);

– compatibility with existing scientific knowledge;

– explanatory power, i.e., the hypothesis should imply a number of facts and consequences that confirm it (the greater the number of derived facts, the stronger the explanatory power);

– simplicity, i.e., it should not contain arbitrary assumptions or subjective additions.

The facts of experience in a certain limited scientific field, together with hypotheses that have been strictly proven, form a theory. A theory is a coherent system of reliable knowledge and represents the highest form of generalization and systematization of knowledge. Theory is a doctrine of generalized experience (practice) that formulates scientific principles and methods enabling one to generalize and understand existing processes and phenomena, analyze the influence of various factors on them, and propose recommendations for their use in practical human activity. A theory not only describes a set of facts but also explains them, revealing the origin and development of phenomena and processes, their internal and external relationships, and causal and other dependencies. All statements and conclusions contained in a theory are substantiated and proven.

The structure of a theory is formed by concepts, judgments, laws, scientific propositions, teachings, ideas, and other elements.

A concept is a thought that reflects essential and necessary features of a certain set of objects or phenomena.

A category is a general, fundamental concept that reflects the most essential properties and relations of objects and phenomena.

A scientific term is a word or phrase that denotes a concept used in science. The set of concepts (terms) used in a particular science constitutes its conceptual apparatus. A judgment is a thought in which something is affirmed or denied.

A principle is a basic proposition of a field of science; it is an initial form of systematizing knowledge (e.g., axioms of Euclidean geometry, Bohr's postulate in quantum mechanics, etc.).

An axiom is a proposition taken as a starting point without proof, from which other propositions are derived according to established rules. Logical axioms include, for example, the law of identity, the law of non-contradiction, and the law of excluded middle.

A law is a proposition expressing the general course of things in a certain domain a statement about how something is necessary or occurs necessarily. Laws are objective and express the most essential, stable, causally conditioned connections and relations between phenomena and processes.

A proposition is a scientific statement, a formulated thought. A teaching (doctrine) is a set of theoretical propositions about a certain domain of reality.

A concept (conceptual framework) is a system of theoretical views united by a scientific idea (or ideas) – the main guiding thought.

The empirical level of research is characterized by the predominance of sensory cognition (studying the external world by means of the senses). At this level, forms of theoretical cognition are present but play a subordinate role.

The formation of the theoretical level of science leads to a qualitative transformation of the empirical level. Before the formation of theory, empirical material that served as its prerequisite was formed on the basis of everyday experience and natural language; with the transition to the theoretical level, it is «seen» through the prism of theoretical concepts, which begin to guide the formulation of experiments and observations – the main methods of empirical research.

The structure of the empirical level of research consists of facts, empirical generalizations, and laws (dependencies).

The concept of a fact is used in several meanings:

a) an objective event or result relating to objective reality or to the sphere of consciousness and cognition;

b) knowledge about an event or phenomenon whose reliability has been proven;

c) a statement recording knowledge obtained during observation and experiment.

For the success of scientific research, it must be properly organized, planned, and carried out in a certain sequence. These plans and sequences depend on the type, object, and goals of the research. For example, if research is conducted on technical topics, first the main document – the feasibility study – is developed; then theoretical and experimental research is performed, a scientific and technical report is prepared, and the results are introduced into production [2,3].

2.2 Efficiency of Scientific Research

Economic efficiency of scientific research as a whole is understood as a reduction in the costs of social and living labor in the production of goods in the sector where completed research projects and design-and-development works (R&D and engineering development) are implemented. The main types of efficiency of scientific research are:

a) economic efficiency – growth of national income, increased labor productivity and product quality, reduced costs of research;

b) strengthening national defense capability;

c) socio – economic efficiency – elimination of heavy labor, improvement of sanitary and hygienic working conditions, environmental purification, etc.

d) prestige of domestic science.

Science is the most effective area for capital investment. In world practice, it is commonly believed that the return on investment in science amounts to 100 - 200% and exceeds the profitability of any industry. According to foreign economists, for every dollar spent on science, the annual return is 4 – 7 dollars or more.

Each year, science becomes more costly for society; enormous sums are spent on it. Therefore, another problem arises in the economics of science: the systematic reduction in national research costs while increasing the impact of its implementation. In this regard, the efficiency of scientific research is also understood as conducting R&D as economically as possible.

It is well known how important the accelerated development of science and scientific-technological progress is today. This is driven by deep strategic reasons that boil down to the objective fact that science and its applications have become a real productive force - the most powerful factor in the effective development of social production.

There are two fundamentally different paths in economic development: extensive and intensive. The extensive path means expanding factory space, increasing the number of machines, and so on. The intensive path implies that each factory, each operating machine, and each hectare of cultivated land produces increasing output. This is ensured through new scientific and technological opportunities: new means of labor, new technologies, and new knowledge. Intensive factors also include the growth of workers' qualifications and the entire set of organizational and scientific-technical solutions used in modern production.

Today, approximately every hryvnia invested in science, technological progress, and the implementation of innovations (new equipment, new technologies) in production yields an effect four times greater than the same hryvnia invested in extensive factors. This leads to the conclusion that Ukraine's economic policy should be oriented toward solving

problems of further development primarily through intensive factors. A special role is given to science, and the same requirement applies to science itself.

Consider indicative figures: over the last 40–50 years, the amount of new knowledge in the world has increased approximately two to three times, while the volume of information (publications, documentation) has increased eight to ten times, and expenditures on science – more than 100 times. These figures are thought-provoking because the growth of resources spent on science is not an end in itself. Therefore, scientific policy needs to change, and the efficiency of scientific institutions must be decisively improved.

However, the main interest lies not only in the growth of knowledge but also in the growth of effect in production. This requires analysis of the proportions between knowledge acquisition and its application in production and, accordingly, rapid growth in investments to implement scientific and technological progress in production.

There is a theoretical model aimed at the fullest use of new knowledge. According to this model, if appropriations for fundamental research are treated as a single unit, the corresponding indicators are: applied research – 4; development – 16; implementation of innovations in production – 250. This model was proposed by Academician V. M. Glushkov, based on the assumption that all useful outcomes of fundamental research will be used, that applied sciences and developers will have sufficient capacity to convert them into technologies and designs, and that production will have sufficient investments and capacity to adopt and implement all necessary innovations.

If total expenditures on fundamental and applied research and on design-and-development works are taken as one unit, then the ratio between investments in producing new knowledge and investments in mastering this knowledge in the national economy would be 1:12. In reality, this ratio is 1:7, indicating that the economy often lacks spare capacities and flexibility (in the USA, the ratio is 1:11).

In modern science, every fourth person is a manager – this is a real fact. There are more managers in science than physicists, chemists, mathematicians, etc., taken separately. Specialists are trained by universities and usually have a high level of professional expertise, but they are not formally trained in scientific management. They

learn it on their own, often in the least productive way – through mistakes. Solving this issue could also raise the efficiency of scientific research.

One way to increase efficiency is the use of so-called accompanying or intermediate results, which are often not used at all or are used late and insufficiently. For example, space programs: what justifies them economically? As a result of their development, radio communication improved, long-distance television broadcasting became possible, weather forecasting accuracy increased, major fundamental scientific results were obtained, etc. All this has or will have economic significance.

The efficiency of research labor is directly affected by the timeliness of scientific publications, primarily periodicals. Analysis of the time articles remain in the editorial offices of domestic journals showed that they are delayed twice as long as in similar foreign publications.

It is known that the growth rate of instrumental equipment in modern science should exceed the growth rate of employment in this sphere by approximately 2.5–3 times. Nationwide, this indicator is still insufficiently high, and in some scientific organizations it is noticeably less than one, leading to a de facto decrease in the efficiency of intellectual resources.

Modern scientific instruments become obsolete so quickly that after 4–5 years, they are usually hopelessly outdated. At current rates of technological progress, so-called careful exploitation of an instrument (only a few hours per week) looks absurd. It would be rational to buy fewer instruments but the most advanced ones, load them maximally without fear of wear, and after 2–3 years of intensive use replace them with newer models. Domestic industry renews its products every five years or more and releases only 10 - 13% of them at the level of world standards. Among the reasons are dispersion and weakness of scientific potential in relevant enterprises, making them unprepared to adopt something essentially new, and even more so to develop it with their own scientists and engineers.

In modern science, the key issue is personnel. It should be acknowledged that, overall, the industrial sector of science is still poorly provided with highly qualified research staff. For every hundred central factory laboratories there is only one Candidate of Sciences. Most factory research units, compared with ordinary research institutes, have several times fewer Doctors and Candidates of Sciences.

Special attention should be paid to the problem of targeted training of personnel for the industrial sector of science. Various criteria are used to assess research efficiency. Fundamental research begins to yield returns only after a significant period, and its results are often applied widely, sometimes in unexpected fields. Therefore, planning the results of such research is difficult. Fundamental theoretical research is hard to assess quantitatively; usually only qualitative criteria can be established:

– the possibility of broad application of results in different sectors of the national economy;

– novelty of phenomena that gives a strong impetus to key areas of research;

– significant contribution to national defense;

– national scientific priority;

– areas where applied research may begin;

– broad international recognition;

– fundamental monographs and their citation by scientists in different countries.

Applied research is easier to evaluate; various quantitative criteria are used. Conclusions about efficiency can be made only after completion and implementation, when research begins to produce returns for the economy. The time factor is of great importance, so applied topics should be developed as quickly as possible; ideally, their duration should not exceed three years. For most applied studies, the probability of obtaining an effect in the economy within this time exceeds 80%.

How can one evaluate the efficiency of a research team (department, chair, laboratory, etc.) and of an individual researcher? A researcher's efficiency is assessed by various criteria: publication output, economic indicators, novelty of developments, citations, and others. The publication criterion reflects overall activity—the total number of printed works, their total volume, the number of monographs, textbooks, and teaching aids. However, this criterion is not always objective: fewer publications may sometimes yield greater impact than many minor works.

Economic evaluation of an individual scientist is used rarely; more often, labor productivity indicators are applied. Novelty is measured by the number of inventor's certificates and patents. Citation reflects the number of references to the scientist's publications and is a secondary criterion.

The effectiveness of a research group or organization is assessed by several criteria: average annual output of R&D, the number of implemented topics, economic efficiency from implementation of R&D and development works, total economic effect, the number of inventor's certificates and patents, the number of licenses sold, or foreign currency revenue.

The economic effect from implementation – the main indicator of research efficiency – depends on implementation costs, scale, time of adoption, and many other factors. The effect is calculated for the entire period from the beginning of development to the receipt of returns, which for applied research typically lasts several years.

The novelty level of applied research and development is characterized by the number of completed works that resulted in inventor's certificates and patents. More objective are relative indicators, such as the number of certificates and patents per number of employees or per number of relevant topics.

Three types of economic effect are distinguished: preliminary, expected, and actual. Preliminary effect is determined when justifying the research topic and including it in the plan. It is calculated using approximate aggregated indicators, considering the forecasted scale of implementation in the relevant industry.

Expected effect is calculated during the execution of R&D and is forecast for a specific implementation period (year). It may be calculated for a longer period as an integrated result – up to 10 years for new materials and up to 5 years for designs, instruments, and technological processes.

The actual effect is determined after implementation, but not earlier than one year later. It is calculated using actual costs and specific economic indicators of the sector (enterprise) where implementation occurred. Actual savings are usually somewhat lower than expected ones because expected values are often estimated by research institutes, while actual values are measured by implementing enterprises.

The most reliable criterion of economic efficiency is actual savings obtained from implementation.

2.3 Implementation of Completed Scientific Research in Production

Implementation is the achievement of practical use of progressive ideas, inventions, and research results (innovations). Implementing innovations requires restructuring established production, retraining personnel, and capital expenditures, and it is simultaneously associated with the risk of failing to obtain the desired result and incurring losses.

Customers for R&D may include technical departments of ministries, enterprise administrations, and research institutes. Contractors are research organizations that perform R&D under a bilateral contract agreement. They are obliged to formulate a proposal for implementation. Such proposals should contain technical specifications, a technical assignment, design documentation, temporary instructions, guidelines, and so on.

The implementation process consists of two stages: pilot-production implementation and serial (mass) implementation of scientific achievements, new equipment, and new technologies.

No matter how carefully R&D is conducted in research organizations, they still cannot fully account for all factors acting under production conditions. Therefore, at the first stage of implementation, the scientific development requires experimental verification in production settings. Proposals for completed R&D are reviewed by scientific and technical councils, and in cases of particularly costly proposals, by ministerial boards, and then sent to production for practical application.

After pilot-production testing, new materials, designs, technologies, recommendations, and methods are introduced into serial production as elements of new technology. At this second stage, research organizations do not participate directly in implementation; upon request from implementing organizations, they may provide consultations or minor scientific-technical assistance.

After implementing scientific and technological achievements in production, an explanatory note is prepared, including attached implementation and operational test reports, calculations of economic efficiency, certificates of the annual implementation volume, protocols for shared participation of organizations in development and

implementation, payroll fund calculations, and other documents. The implementation of scientific and technological achievements is financed by the organizations that carry them out [1-3].

Topic 3. Methodological Foundations of Scientific Knowledge

3.1 Methodology of Scientific Research

In a broad sense, methodology is a system of principles and ways of organizing and constructing theoretical and practical activity, as well as the doctrine of this system. Another definition of methodology is «the doctrine of the method of scientific cognition and transformation of the world». The methodology of science characterizes the components of scientific research – its object, subject, tasks, and the set of means needed to solve research tasks – and also shapes an understanding of the sequence of actions a researcher follows while solving a problem.

A method, or the path of research, is a way to achieve a certain goal, a set of techniques and operations for practical or theoretical mastering of reality. In science, a method is the path of cognition that a researcher lays out toward the subject of study. Thus, a scientific research method is a way of knowing objective reality.

Methods of the empirical level include: observation, description, comparison, calculation, measurement, questionnaire survey, interview, testing, experiment, modeling, etc. Methods of the theoretical level include: the axiomatic method, the hypothetical method, formalization, abstraction, general logical methods (analysis, synthesis, induction, deduction, analogy), and others.

A procedure (way) is an action or a system of actions applied in performing a task or carrying out something. A methodology (technique) can be defined as a set of ways and methods of cognition. Any scientific research is carried out by certain techniques and procedures, according to specific rules.

3.2 General Scientific and Philosophical Methodology: Essence and General Principles

Among philosophical methods, the best known are the dialectical and metaphysical methods. These methods may be associated with different philosophical systems.

When studying objects and phenomena, dialectics recommends proceeding from the following principles:

1. Consider the objects under study in the light of dialectical laws:
   a) the unity and struggle of opposites;
   b) the transition of quantitative changes into qualitative ones;
   c) the negation of negation.
2. Describe, explain, and predict the phenomena and processes under study relying on philosophical categories: the general, the particular, and the singular; content and form; essence and phenomenon; possibility and reality; necessity and chance; causes and effects.
3. Treat the object of research as an objective reality.
4. Consider the objects and phenomena under study:
   a) comprehensively;
   b) in their general connection and interdependence;
   c) in continuous change and development;
   d) historically.
5. Verify the obtained knowledge in practice.

Metaphysics considers things and phenomena in isolation, separately, independently of one another. Metaphysical thought is directed toward what is simple, single, and whole.

All general scientific methods for analysis can be divided into three groups: general logical, theoretical, and empirical. General logical methods include analysis, synthesis, induction, deduction, and analogy.

Analysis is a method of research by which the studied phenomenon or process is mentally divided into component elements in order to study each separately. Types of analysis include classification and periodization.

Synthesis is a method that involves mentally combining parts or elements of the studied object and examining it as a whole.

Analysis and synthesis are interconnected and are equally used in scientific research.

Induction is the movement of thought (cognition) from facts and individual cases to a general proposition. Induction leads to general concepts and laws that can form the basis for deduction.

Deduction is deriving the particular from a general proposition; it is the movement of thought from general statements to statements about individual objects or phenomena. Through deductive conclusions, a certain idea is «derived» from other ideas.

Analogy is a way of obtaining knowledge about objects and phenomena based on their similarity to others; it is reasoning in which, from similarity in some features, a conclusion is drawn about similarity in other features as well.

Methods of the theoretical level include the axiomatic method, the hypothetical method, formalization, abstraction, ranking, generalization, the historical method, and the method of systems analysis.

In scientific research, abstraction is widely used – i.e., ignoring secondary facts in order to focus on the most important features of the phenomenon under study. For example, when studying the operation of a mechanism, a calculation diagram is analyzed that reflects its main, essential properties.

Sometimes, analysis of phenomena and processes requires considering a large number of facts (features). In such cases it is important to distinguish the main ones. Then ranking may be applied: everything secondary that does not significantly affect the phenomenon is excluded.

The axiomatic method consists in accepting some statements (axioms, postulates) without proof and then deriving other knowledge from them according to certain logical rules.

In a number of cases, formalization is used. Its essence is that the main propositions about processes and phenomena are expressed in the form of formulas and special symbolism. By operating with formulas of artificial languages, new formulas can be obtained and the truth of a proposition can be proven. Formalization is the basis for algorithmization and programming, without which computerization of knowledge and the research process is impossible. The use of symbols and other sign systems helps establish regularities between the studied facts.

The hypothetical method is based on developing a hypothesis – a scientific assumption containing elements of novelty and originality. A hypothesis should explain phenomena and processes more fully and better, be confirmed experimentally, and correspond to general laws of dialectics and natural science. This method is fundamental and the most widespread in applied sciences.

Generalization is the establishment of general properties and relations of objects and phenomena; the definition of a general concept that reflects essential features of objects or phenomena of a given class. At the same time, generalization may also involve selecting any features (not necessarily essential ones). This method relies on the philosophical categories of the general, the particular, and the singular.

The historical method makes it possible to study the origin, formation, and development of processes and events in chronological sequence in order to reveal internal and external connections, patterns, and contradictions. This method is used mainly in the social sciences – especially history. In applied sciences it may be used, for example, when studying the development and formation of certain fields of science and technology.

A primary means of understanding the essence of processes is observation. Observation is a way of cognition based on direct perception of properties of objects and phenomena through the senses. Each observation can record only some factors. To understand a process more fully, many observations are required. If observation is conducted in a natural environment, it is called field observation; if environmental conditions are specially created by the researcher, it is laboratory observation. Observation results may be recorded in protocols, diaries, cards, electronic media, and other forms.

One of the most important components of scientific research is the experiment – one of the main ways to obtain new scientific knowledge. Unlike ordinary, everyday, passive

observation, an experiment involves an active influence of the researcher on the studied phenomenon.

The main purpose of an experiment is to verify theoretical propositions (confirm a working hypothesis) and to study the research topic more broadly and deeply. An experiment should be conducted, if possible, in the shortest time, with minimal cost, and with the highest quality of results.

Experiments are divided into natural and artificial. Natural experiments are typical when studying social phenomena in real-life settings such as production, everyday life, etc. Artificial experiments are widely used in many natural-science studies; in this case, phenomena are isolated to the necessary degree to evaluate them quantitatively and qualitatively.

Experimental research may be laboratory or industrial (field/production). Laboratory studies use standard instruments, modeling installations, test stands, equipment, etc. They allow high-quality study with necessary repeatability while varying conditions. With sufficiently strong scientific justification (e.g., mathematical experiment planning), laboratory research can yield valuable information with minimal cost. However, laboratory experiments do not always fully reproduce the real course of the process, so there may be a need for production experiments.

Production experimental research aims to study a process in real conditions, taking into account the influence of various random factors in the production environment.

Description is the recording of features of the studied object established through observation, measurement, or experiment. Description may be:
a) direct, when the researcher directly perceives and notes the features of the object;
b) indirect, when the researcher records features perceived by others.

Counting (a quantitative method) is determining quantitative relationships between objects of study or parameters characterizing their properties.

Comparison is comparing features of two or more objects, identifying differences, or finding common characteristics.

It is difficult to isolate what is essential and then study processes deeply when one has large amounts of unsystematized information. Therefore, such information is «condensed» into an abstract concept – a model.

A model is an artificial system that reflects the main properties of the studied object (the original). A model is a representation of numerical information about the object in a convenient form. It corresponds to the original, can replace it in research, and allows one to obtain information about it.

The method of modeling – studying phenomena through models – is one of the main methods in modern research. One distinguishes physical and mathematical modeling. In physical modeling, the physics of phenomena in the object and the model (and their mathematical relationships) is the same. In mathematical modeling, the physics may differ, but the mathematical relationships are the same. Mathematical modeling is especially valuable when very complex processes need to be studied.

When building a model, the object and its properties are usually simplified and generalized. The closer the model is to the original, the better it describes the object, the more effective the theoretical study, and the closer the obtained results are to the research hypothesis.

Models may be physical, mathematical, or full-scale (natural). Physical models allow visual representation of real processes and help study the influence of parameters on physical processes. Mathematical models allow quantitative study of phenomena that are difficult to investigate using physical models. Full-scale models are scaled objects that allow the most complete investigation of processes under real conditions.

There are no standard recommendations for choosing and constructing models. The model must reflect essential phenomena of the process. Minor factors, excessive detail, secondary phenomena, etc. only complicate the model and make theoretical research cumbersome and unfocused. Therefore, the model should be optimally complex, preferably visual, but most importantly sufficiently adequate – i.e., able to describe the regularities of the studied phenomenon with the required accuracy.

To build the best model, deep and comprehensive knowledge is needed not only of the topic and related sciences but also of the practical aspects of the studied task [2,3].

3.3 Formulating the Topic of Scientific Research

The entire course of scientific research can be represented by the following logical scheme:

– determination of the object and subject of research, selection of the topic;

– justification of the relevance of the chosen topic;

– formulation of the goal and specific research tasks;

– selection of the research method (methodology);

– description of the research process;

– discussion of research results;

– formulation of conclusions and evaluation of obtained results.

The preparatory stage of research work is selecting the research topic. A research topic may relate to a certain scientific direction or to a scientific problem. A scientific direction is understood as a field of research conducted by a scientific team aimed at solving major fundamental theoretical and experimental tasks in a given branch of science. Structural units of a direction are complex problems, problems, topics, and questions.

A complex problem contains several problems. A scientific problem is a set of complex theoretical or practical tasks; a set of research topics. A problem covers a significant research area and has a перспективне (long-term) value. A problem may be sectoral, intersectoral, or global. A problem consists of a number of topics.

A topic is a scientific task that covers a certain area of research and is based on many research questions. Research questions are smaller scientific tasks related to a specific area of research.

Topics may be theoretical, practical, or mixed. Theoretical topics are developed mainly using literature sources. Practical topics are developed on the basis of studying, generalizing, and analyzing facts. Mixed topics combine theoretical and practical aspects. When developing a topic or question, a specific research task is proposed – for example, to develop a new design, an advanced technology, a new methodology, etc.

Selecting topics requires careful study of domestic and foreign sources in the given and related specialties.

Formulating (selecting) problems or topics is a difficult and responsible task and includes several stages.

Stage 1: formulation of problems. Based on analysis of contradictions in the studied direction, the main question – the problem – is formulated, and the expected result is defined in general terms.

Stage 2: developing the structure of the problem. Topics, subtopics, and questions are identified, forming a «problem tree». For each topic, the approximate research area is determined.

Stage 3: establishing the relevance of the problem – its value at the given stage for science and technology. Several objections are proposed for each topic, and through analysis (the method of research approximation), objections are eliminated in favor of the topic's reality. After such «purification», the problem structure is finalized and topics/subtopics/questions are coded.

When choosing, it is important to distinguish pseudoproblems from scientific problems. Pseudoproblems (false, imaginary) may have an external scientific form but are anti-scientific in essence.

After the problem is justified and its structure established, the researcher (or team) usually independently selects a research topic. Some scholars believe selecting a topic is often more difficult than conducting the research itself. Several requirements apply.

The topic must be relevant – important and requiring solution at the present time. This is one of the main requirements. There is no strict criterion for determining the degree of relevance; in theoretical research it may be assessed by experienced scholars or a research team. In applied research, errors are less likely: the topic that provides a greater economic effect is often considered more relevant.

The topic must solve a new scientific task. This means the topic in such a formulation has never been studied before and is not being studied at present; duplication is excluded. Duplication may be justified only when instructed by leading organizations for competing teams to solve crucial state problems in the shortest time.

The topic must be economically efficient and significant. Any applied research topic should yield an economic effect in the national economy. At the stage of topic

selection, the expected economic effect is usually estimated approximately; sometimes it cannot be determined at all. Then analogues may be used for approximate evaluation. In theoretical research, economic efficiency may be secondary to significance—e.g., research that determines the prestige of domestic science, lays a foundation for applied studies, or aims to improve social and production relations [3].

3.4 Justifying the Relevance of the Chosen Topic

Relevance (from Latin actualis – actually existing; real, modern) is the importance and significance of something at a given moment, its topicality. Relevance is the significance of the studied problem in social life and the justification of the reasons for choosing the research topic. The relevance of a research topic is the degree of its importance at the current moment and in the given situation for solving a particular problem.

Relevance is a mandatory requirement for any scientific study; therefore, the introduction should begin with justification of the relevance of the chosen topic. The way an author can select a topic and how correctly they understand and evaluate it from the perspective of modernity and social significance characterizes their scientific maturity and professional readiness. The key is to show the essence of the problematic situation, which makes the relevance clear.

Relevance is one of the main criteria in research evaluation and means that the tasks posed in the study require a prompt solution for practice or for the corresponding field of science. Relevance is revealed as the relevance of the research object and the research subject.

The relevance of the research object should be obvious to specialists and not cause doubt. It is obvious when specialists recognize a real problem in the field—e.g., something cannot be explained at the current level of theory; it is impossible to measure with the required accuracy on the existing experimental base; experimental data do not match existing understanding; production is too expensive; quality is insufficient; reserves are unused; automation is needed, etc.

Relevance is justified on both scientific and applied grounds.

Scientific relevance means that:

– tasks of fundamental sciences require developing the topic to explain new facts;

– refinement, development, and solving of the research problem are possible and urgently needed in modern conditions;

– theoretical propositions can remove existing discrepancies in understanding the process or phenomenon;

– hypotheses and regularities make it possible to generalize earlier known and author-obtained empirical data and to predict the course of phenomena and processes.

Applied relevance means that:

– tasks of applied research require solving issues within this topic;

– there is an urgent need to solve research tasks for society, practice, and production;

– research significantly improves the quality of developments of creative and scientific teams in a particular field;

– new knowledge contributes to personnel qualification improvement or can be included in educational curricula.

3.5 Defining the Research Object and Research Subject

The research object is the knowledge that generates a problematic situation, organized into a concept or system of concepts, and defined as the sphere of scientific inquiry in the given study. An index of the Universal Decimal Classification (UDC) is selected for the research object.

The research subject can be defined as new scientific knowledge about the research object obtained by the author as a result of scientific inquiry. The subject may also include an instrument for obtaining this new knowledge if it has essential features of novelty. The research subject, as a rule, lies within the bounds of the research object.

A simple way to construct the research subject is to select a list of issues to be considered and arrange them in the order in which they will be analyzed. This forms the research scheme. Each item is supplemented with a characteristic of novelty, usefulness,

and reliability. Some authors present the research subject as applied or theoretical models that are analyzed, studied, and adapted to specific tasks [4].

3.6 Setting the Goal and Specific Research Tasks

After proving the relevance of the chosen topic, one should logically move to formulating the goal of the research and specifying the concrete tasks that must be solved to achieve this goal.

The process of setting research tasks can be represented by the following stages:

1. Identifying the need to solve a specific scientific task. The need may arise due to the necessity to explain an empirical fact, predict the result of influence, resolve a technical contradiction, or address an administrative contradiction. Sometimes the need must be planned (e.g., in military technology development). Thus, the need for new scientific knowledge emerges.

2. Establishing the need to conduct scientific research. Research is not required if the expected result is known and publicly available. As a rule, only one scientist or a small group becomes recognized as the discoverer of a scientific fact or theory. To make new facts widely known, they must be published in leading scientific journals, often translated into foreign languages.

Researchers should also become accustomed to the fact that there is serious competition in science. At the same time, methods and results for solving the same task may differ significantly in form and substance; this should be used appropriately for critique and justification of one's own viewpoint.

After a thorough literature review of leading scientific and popular-science publications, if no similar solutions are found, the researcher should plan a full-scale study to obtain an original solution.

3. Defining and ranking the goals of the research. The need to solve a scientific task is embodied in the research goal. The main goal is obtaining new scientific knowledge about reality in a specific field. The product of engineering activity is a project, technology, or invention; society often values these mainly for practical results. New knowledge is the core goal of scientific research.

4. Systematizing the subject area of the study. Systematic organization is a key sign of scientific character. Scientific systematization aims at completeness, clarity of systematization foundations, and lack of contradictions. The vast field of scientific knowledge is divided into disciplines.

Systematic organization is achieved through the ability to classify the research object and subject. Classification not only makes the research systematic but also precisely defines the scientific niche being developed. Successful classifications possess the properties of a system; a classic example is the periodic table of chemical elements.

5. Defining conditions and constraints. This allows assessment of feasibility. Constraints may be time-related, material, informational, or energy-related.

6. Defining the research tasks. At this stage, tasks are formulated as the research goal under given initial data and constraints in space, time, materials, energy, and information. Constraints and conditions transform a fantastical project into a scientific task or problem.

Typically, several tasks are formulated, reflecting different aspects of the general problem: development of theoretical propositions, testing, development of new methods, and recommendations for using new knowledge.

Scientific research may involve generalizing accumulated material by describing new phenomena, social and technical processes, statistical or empirical data; transferring methods from one field to another; developing new scientific problems at the boundary of knowledge; refining known phenomena using the full arsenal of methods; or conducting deep empirical studies that yield practical recommendations.

Originality may also appear through new calculation methodologies for systems or processes based on mathematical and computational methods not previously applied, enabling simplification or removal of assumptions and thus leading to new results and a new vision of the phenomenon.

3.7 Choosing the Method (Methodology) for Conducting Research

A crucial stage is selecting research methods, which serve as tools for obtaining factual material and are necessary for achieving the goal. The most important

methodological position is building the research theory. In theoretical work, the author must develop a complete concept and prove its validity by comparing it with other viewpoints and referring to practice.

Useful methods for developing theoretical propositions include systems analysis, which examines the full set of techniques, processes, equipment, and problem-solving methods. Following formal logic, classifications of analysis objects are created; items not within the research subject are criticized and excluded; advantages of proposed solutions are substantiated; and steps for implementation are specified. This method is productive for developing recommendations.

Another universal method is modeling of a process or phenomenon based on known models, with essential differences achieved through removing assumptions, using new effects, or applying new approaches.

A key methodological principle is the unity of theory and practice. This is achieved by building theory (description, explanation, prediction, and recommendations) oriented toward practice, ensuring systematization, typicality, and representativeness, and revising concepts when new facts arise.

In technical sciences, methods reflecting the specificity of the object and subject include:

– systems approach;

– project method (stages and procedure);

– abstract-logical method (analysis, synthesis, deduction, induction, analogy, formal logic, hypothesis, etc.);

– modeling;

– empirical method (experiments and observations);

– statistical-probabilistic method;

– monographic method (descriptive, but valuable for a deep, comprehensive study).

Methodological soundness of research means the effective use of methodological principles to create a coherent scientific work. Methodologically sound research is characterized by:

– correct and scientifically grounded problem statement, feasible in practice, and producing results with novelty, usefulness, and reliability;

– constructing the subject as a set of interrelated subproblems studied in both static and dynamic perspectives;

– building a theory enabling description, explanation, prediction, and recommendations;

– ensuring unity of theory and practice through analysis of practice and experimental data;

– completeness and integrity, giving the study the properties of a system;

– reliability of results proven through theoretical methods, experiments, and practical observation.

Another important methodological aspect is the interpretation of research foundations and results. Interpretation of the chosen problem, object and subject, information base, methods, goals, tasks, and conclusions is worldview-oriented and is based on objective dialectics, its laws, and categories.

3.8 Formulating Conclusions and Evaluating the Obtained Results

This issue should be treated as forming a system of concentrated presentation of the obtained scientific knowledge. A possible scheme for presenting conclusions is as follows: first, list the results presented in the research to outline the research subject; then one or several points may reveal the new knowledge more deeply and specify its uniqueness and difference from known propositions; finally, the conclusions should confirm reliability and validity of scientific propositions and the usefulness of their practical application.

Between conclusion points, there should be connection, sequence, and hierarchy by importance. Thus, in conclusions the author should provide a scientific generalization, show the uniqueness of their research, and present new knowledge to the scientific community. Scientific novelty is the key requirement for research results. This means the result must contain a new solution to a scientific task significant for the given field, or new

scientifically grounded developments ensuring the solution of important applied tasks of the economy or national defense.

Scientific novelty can be identified through:

– detailed study of literature with analysis of historical development;

– analysis and comparison of existing viewpoints, often leading to new or compromise solutions;

– introducing new numerical and factual material, e.g., from experiments (a clear claim to originality);

– detailed study of a known process or phenomenon, which often yields new results and conclusions.

Elements of novelty that may be presented include:

– a new research object (the task is considered for the first time);

– a new formulation of known problems/tasks (removal of assumptions, new conditions);

– a new solution method;

– a new application of a known method/solution;

– new consequences from a known theory under new conditions;

– new experimental results and their implications;

– new or improved criteria and indicators with justification;

– development of original mathematical models of processes and phenomena;

– development of devices and methods at the level of inventions and utility models [3,4].

Topic 4. Scientific Information: Search, Accumulation, and Processing

4.1 Scientific Information and Its Sources

Intellectual work in any form is always associated with the search for information. Today, this search is becoming increasingly complex, turning into a specialized field of knowledge. Competence in working with scientific information is now a mandatory requirement for any professional.

Preparedness in this area includes the following key components:

– a clear understanding of the overall system of information resources and the opportunities provided by information sources in a given field;

– knowledge of all possible sources of information within one's specialty;

– the ability to choose the most rational search strategy depending on objectives and conditions;

– skills in using auxiliary bibliographic and information materials.

A characteristic feature of modern science is the rapid growth of scientific data obtained as a result of research. Every year, more than 500,000 books are published worldwide, along with an even larger number of scientific journals. Despite this, a significant amount of scientific information remains unpublished.

Scientific information tends to age, due to the emergence of new data or a decrease in demand for older information. According to international data, the approximate rate of obsolescence is:

– 10% per day for newspapers;

– 10% per month for journals;

– 10% per year for books.

As a result, identifying truly novel and advanced scientific knowledge is a difficult task, even for large research teams. Insufficient use of global information resources leads to duplication of research: in some scientific and technical fields, repeated results account for 60–80%, causing multi-billion-dollar losses annually.

Scientific information is logical information obtained in the process of cognition that adequately reflects the laws of the objective world and is used in socio-historical practice. Thus, scientific information must meet several conditions:

– it is obtained in the process of cognition and is inseparable from practical activity;

– it is logically processed through abstract and logical thinking;

– it adequately reflects objective reality;

– it is used in socio-historical practice.

For this reason, scientific fiction or information collected for purely personal purposes cannot be considered scientific.

A source of scientific information is not the institution (library, archive) but the document containing the information. Documentary sources form the main body of knowledge used in scientific, educational, and practical activities.

Documents create powerful information flows, which are divided into:

– ascending flows (from researchers to registration and information bodies, including submitted articles and research plans);

– descending flows (bibliographic, abstract, and review information provided to users upon request).

All documentary sources are classified as primary or secondary:

– primary documents contain original research results (monographs, dissertations, conference proceedings);

– secondary documents are analytical and logical interpretations of primary sources (bibliographic, reference, and review publications) [3-5].

4.2 Working with Information Sources

The search for scientific information begins with understanding where it can be found and how information institutions operate.

Libraries – especially scientific and specialized libraries – serve researchers, educators, and professionals.

Scientific and technical information bodies form a unified system designed to collect, analyze, and disseminate information for both organizations and individuals.

Within research institutions and enterprises, information departments maintain reference-information funds consisting of:

– reports on completed research;

– project documentation;

– patents and author certificates;

– standards;

– technical descriptions;

– translations and reference materials.

Working with Books. The ability to work effectively with a book includes evaluating its relevance, understanding its structure, and recording valuable information in a convenient form. Reading scientific literature requires effort, as it involves mastering new concepts and following the author's logic.

Common mistakes include:

– lack of purpose in reading;

– insufficient use of reference tools;

– inefficient note-taking methods.

Reading Techniques. Reading scientific literature usually follows two stages:

1. Preliminary review.
2. Thorough study.

Preliminary review helps determine whether the book is worth detailed reading. It includes analyzing:

– title;

– author;

– publisher;

– publication date;

– abstract;

– table of contents;

– preface;

– reference and bibliographic apparatus.

Thorough reading involves deep comprehension rather than memorization. Understanding requires reconstructing the author's reasoning, identifying key ideas, and distinguishing core arguments from examples.

Comprehension is enhanced by:

– outlining main ideas;

– creating logical or graphical schemes;

– highlighting and numbering key points.

Special attention must be paid to terminology. Any unclear terms should be clarified using dictionaries and reference materials.

Note-Taking. Reading scientific literature must be accompanied by note-taking. Notes help retain information, reduce repeated searches, and improve understanding.

Common forms include:

– textual notes (summaries) – concise presentation of main ideas;

– tabular notes – useful for comparative analysis;

– graphical notes – hierarchical diagrams showing relationships between concepts.

A personal glossary of terms is an important analytical tool, requiring careful interpretation and verification of definitions.

4.3 Patent Research

Patent research is directly related to innovation profitability and competitiveness. It allows assessment of patentability and prevention of intellectual property infringement.

Patent research is the study of the technical level, development trends, novelty, and patent purity of technical objects based on patent information.

Patent purity means the ability to use a technical solution freely in a given country without violating existing patents.

Patent research includes:

– analysis of technical development trends;

– assessment of novelty;

– analysis of patent purity;

– evaluation of patent and licensing activity;

– justification for legal protection.

Patent research is grouped into four areas:

– analysis of technological development trends;

– novelty assessment;

– patent purity assessment;

– patent and licensing strategy analysis.

A key tool is the International Patent Classification (IPC), which divides inventions into sections (A – H), classes, subclasses, groups, and subgroups. Patent searches begin with identifying relevant IPC categories and reviewing patent descriptions, bulletins, and abstract journals. Results are documented in a patent search report [2-4].

4.4 General Requirements for Scientific Research Papers

All research results are documented in a scientific paper containing systematically organized information.

General requirements include:

– logical structure;

– clarity and precision;

– substantiated conclusions;

– concise and unambiguous formulations.

A typical structure includes:

– title page;

– table of contents;

– introduction;

– main body;

– conclusions;

– references;

– appendices.

Scientific writing is characterized by objectivity, logical coherence, and absence of emotional language. Visual materials (tables, graphs, diagrams, formulas) must be properly labeled, referenced, and formatted.

4.5 Requirements for Writing and Defending Qualification Theses

A thesis is a final qualification work demonstrating the student's theoretical knowledge, practical skills, and ability to solve professional problems independently.

Key stages include:

– topic selection;

– literature review;

– planning;

– methodology selection;

– data analysis;

– writing and formatting;

– defense preparation.

The defense involves an oral presentation (10 – 15 minutes), visual materials, responses to questions, and evaluation by the examination committee.

Assessment criteria include:

– relevance and novelty;

– theoretical and practical value;

– quality of analysis;

– independence of work;

– clarity of presentation;

– compliance with formal requirements.

Topic 5. Fundamentals of Intellectual Property

5.1 The Concept of Intellectual Property

With Ukraine's transition from a planned to a market economy and its integration into the global community, the role of results of intellectual (creative) activity has increased significantly in the economic and social development of society. Such results include inventions, utility models, industrial designs, trademarks, geographical indications, plant varieties and animal breeds, trade secrets, literary and artistic works, databases, computer programs, phonograms, videograms, and many other outcomes.

These results are referred to as objects of intellectual property rights or IP objects. Intellectual property (IP) is the foundation of an innovation-driven economy. IP is used in all forms of economic activity; therefore, every citizen, and especially every higher-education student, should understand its basic principles.

The legal mechanism for protecting creators' rights aims to:

– stimulate further creative work and research;

– guarantee fair remuneration to the creator;

– create financial conditions for implementing new ideas.

Creative activity (creativity) is a type of activity that produces something qualitatively new, characterized by originality, uniqueness, and socio-historical significance. The key feature of creativity is novelty: a creative result cannot be merely a repetition of what is already known.

Intellectual property refers to the results of the creative activity of individuals. However, the protected object is not the material carrier itself (paper, disk, device) but the ideas, images, symbols, solutions, and forms of expression embodied in that carrier.

According to Article 418 of the Civil Code of Ukraine, the right of intellectual property is the right of a person to the result of intellectual creative activity or another IP object defined by the Civil Code and other laws.

A fundamental feature of IP is that it includes two groups of rights:

1. Moral (personal non-property) rights of the creator. These rights belong only to the creator (a natural person) and include:

– the right to be recognized as the author / inventor / performer;

– the right to prevent actions that may damage the creator's honor and reputation;

– other moral rights defined by law for specific IP objects.

Moral rights are inseparable from the author and generally do not expire.

2. Economic (property) rights. These include:

– the right to use the IP object;

– the exclusive right to prevent unlawful use (including prohibition);

– other economic rights defined by law.

Unlike moral rights, economic rights can belong not only to the creator but also to another person (individual or legal entity), and they are typically limited by time and territory.

Human creativity is usually divided into:

– artistic creativity (literary and artistic works);

– technical creativity (inventions, trademarks, trade secrets, etc.).

5.2 Classification of IP Objects

IP objects are usually divided into industrial property and copyright and related rights.

Industrial property. Includes:

– inventions, utility models;

– industrial designs (appearance/design of products);

– trademarks (signs for goods and services);

– geographical indications and designations of origin;

– trade (commercial) names;

– plant varieties, animal breeds;

– topographies of integrated circuits, etc.

Industrial property also includes protection against unfair competition, meaning business practices that contradict honest commercial customs.

Copyright and related rights. Copyright protects works created through intellectual creative activity, mainly in areas related to communication and culture:

– printed publications,

– radio and television broadcasting,

– film distribution,

– computer systems for storage and reproduction of information.

A key principle: copyright protects the form of expression of an idea, not the idea itself. Legal protection arises once the idea is embodied in an objective form (text, notes, graphics, recording, etc.).

Related rights cover the rights of:

– performers;

– producers of phonograms and videograms;

– broadcasting organizations.

Thus, civil law traditionally contains two major institutions:

– copyright and related rights;

– patent law / industrial property law [4,5].

5.3 The System of Ukrainian IP Legislation

In Ukraine, IP relations are regulated by:

– the Constitution of Ukraine (Articles 41 and 54),

– the Civil Code of Ukraine (Book 4: «Intellectual Property Rights»),

– the Criminal Code of Ukraine,

– the Code of Ukraine on Administrative Offenses.

In addition, Ukraine has a system of special IP laws, including laws on:

– protection of rights to inventions and utility models;

– industrial designs;

– marks for goods and services (trademarks);

– plant varieties;

– indications of origin;

– topographies of integrated circuits;

– copyright and related rights;

– protection of economic competition;

– distribution of audiovisual works and phonograms;

– regulation of production/export/import of disks for laser reading systems.

If disputes involve parties from different states, international treaties to which Ukraine is a party may take precedence over national legislation.

Institutional roles (general understanding):

– Ukrpatent conducts examination of applications for industrial property objects;

– a state authority issues protection documents (patents, certificates) according to established procedure.

5.4 Objects of Industrial Property

5.4.1 Inventions

An invention is a technical solution in any field that meets patentability requirements:

– novelty;

– inventive step;

– industrial applicability.

Novelty means the invention was not disclosed so that it could be used before the filing date (priority date). If the inventor disclosed the information, novelty may still be preserved if disclosure occurred no earlier than 12 months before filing (a «grace period» principle in the presented material).

An inventive step means the solution is not obvious to a specialist from the prior art.

Industrial applicability means the invention can actually be used in practice (industry, agriculture, etc.) and is technically feasible [4,5].

5.4.2 Utility Models

A utility model is typically a technical solution related to the design (construction) of a device, characterized by clearly expressed spatial forms.

In simplified terms (as in your text):

– an invention contains the essence of the technical proposal;

– a utility model expresses this essence in a constructive form.

A utility model must satisfy:

– world novelty;

– industrial applicability.

5.4.3 Industrial Designs

An industrial design is the external appearance of an industrial product (shape, ornamentation, design features).

5.4.4 Commercial (Trade) Names

A commercial name is the name under which an entrepreneur operates in civil turnover. Its purpose is the individualization of a business among other market participants.

Key principles:

– truthfulness: the name should not mislead consumers;

– exclusivity: the name must be distinguishable from existing ones;

– stability: the name should remain unchanged during the enterprise's existence.

Trade names are protected from the moment of first use (in the logic of the text), not necessarily requiring registration as a mandatory condition.

5.4.5 Trademarks

A trademark is a sign that distinguishes goods or services of one person from others. Signs may be:

– verbal;

– figurative (graphic);

– three-dimensional;

– combined.

A trademark should be:

– new/distinctive;

– not contrary to public interest;

– suitable for marking goods/services;

– aesthetically and ergonomically appropriate (easy to pronounce, remember).

Some designations cannot be registered (e.g., state symbols and their stylizations under international conventions and national restrictions).

Trademarks can be protected through registration (and in some jurisdictions through use). If a registered trademark is not used for a certain time, cancellation may be requested. A trademark may also lose protection if it becomes a generic term [5].

5.4.6 Geographical Indications

A geographical indication (GI) indicates the origin of a product and links its qualities/reputation to a specific place.

GIs may be:

– simple (direct/indirect indication of origin);

– qualified (with stronger legal requirements, depending on law).

Protection generally depends on registration and may be maintained as long as the product characteristics associated with the place are preserved.

5.5 Objects of Copyright and Related Rights

Copyright (objective meaning) is a set of legal norms regulating relations arising from the creation and use of works of science, literature, and art.

Copyright objects include:

– literary and artistic works;

– computer programs;

– databases (if their selection or arrangement is creative);

– other works expressed in an objective form.

A work is a result of creative activity expressed in a form that can be perceived and reproduced (oral, written, audio/video, etc.). Protection does not depend on the purpose, artistic level, or value of the work.

Not protected as copyright objects:

– official documents (laws, court decisions) and their official translations;

– state symbols and signs;

– news of the day as factual messages;

– folklore (in the presented approach);

– ideas (as such).

Related rights protect:

– performances;

– phonograms;

– videograms;

– broadcasting programs.

A sign of related rights protection may be used (℗ or «P in a circle»), usually including:

– name of the right holder;

– year of first publication.

Subjects of copyright:

– authors (creators);

– heirs;

– successors (persons/entities who received economic rights by contract).

The creator is always a natural person, regardless of age and citizenship. If there is no evidence to the contrary, the author is presumed to be the person indicated on the work (presumption of authorship).

5.6 Objects of Scientific and Technical Information

In a market economy, technical and scientific information becomes a valuable asset. Scientific and technical information may be an IP object because it is a product of intellectual effort.

Scientific and technical information (STI) is:

– documented on any medium or publicly announced;

– domestic or foreign;

– related to achievements in science, technology, and production.

Information can be:

– disclosed (often protected by patents);

– undisclosed (protected as confidential information/trade secrets without protection documents).

A limitation of patents (as highlighted in your text) is that the invention must be disclosed in sufficient detail, which may allow competitors to modify and use similar solutions. Therefore, some elements may be intentionally kept outside the patent claims, and businesses often protect part of knowledge as a trade secret.

Trade secret: technical, organizational, commercial, production, or other information unknown to third parties, having commercial value and providing a competitive advantage, protected through confidentiality measures.

State secrets also fall under undisclosed information and are protected through special regimes.

5.7 Subjects of Intellectual Property Rights

Subjects of IP rights may include:

– authors (creators);

– applicants,

– employers,

– heirs,

– successors (individuals/legal entities),

– in some contexts the state (depending on the legal model discussed).

Authors. A person may be a subject of IP rights regardless of citizenship, residence, occupation, age, etc.

Moral rights belong to minors as well. Economic rights (such as concluding certain contracts and receiving remuneration) may arise from a certain age threshold (in the presented material: from 14 years).

Co-authorship may be:

– indivisible (joint work where parts cannot be separated);

– divisible (separable contributions).

Remuneration is generally shared equally unless otherwise agreed.

Applicants. An applicant may be an individual or legal entity. For patents and similar rights, rights typically arise through filing and registration procedures.

Copyright does not require formalities: it arises from creation and fixation. However, optional registration can be used to document and strengthen evidence of authorship.

Heirs and successors. Economic rights may pass by law (inheritance) or by contract (assignment, licensing). After the protection term expires, works usually enter the public domain and may become freely usable.

General Conclusion. Intellectual property is the basis of the innovation-oriented development of Ukraine's economy. IP is not simply the creative result itself, but the legal right to that result, which allows lawful use, control, and protection in scientific, industrial, literary, and artistic fields [3-5].

Control Questions.

1. Define the concept of intellectual property rights.
2. What is creativity?
3. Name the main groups of results of creative activity.
4. Name the main types of intellectual property rights.
5. What is copyright? What are its key features?
6. What is patent law? What are its key features?
7. For how long does copyright protection apply (in general terms)?
8. What are related rights? What are their key features?
9. Describe the system of state protection and enforcement of IP rights.
10. List the subjects of intellectual property rights.
11. Describe the rights of the «Author» subject.
12. Describe the rights of the «Applicant» subject.
13. Describe the rights of the «Heir» subject.

Topic 6. Registration and Legal Protection of Intellectual Property Rights

6.1 Registration of Rights to Industrial Property Objects

An inventor, an employer, or a right holder may choose different legal-protection options:

– to keep information confidential under the legal rules on a trade secret;

– to make the invention publicly known without obtaining a patent (an exhibit at an exhibition, an article, a monograph, etc.);

– to obtain a patent for an invention or a utility model.

A person who wishes to obtain a patent for an invention (utility model) and has the right to do so may file an application for its grant with the State Intellectual Property Service of Ukraine, which accepts, reviews, and examines applications.

On the applicant's instruction, the application may be filed through an intellectual property representative (patent attorney) or another authorized person. Foreign persons and stateless persons who reside or have a permanent place of business outside Ukraine exercise their rights through intellectual property representatives (patent attorneys).

The patent-grant procedure includes the following main steps for the applicant Preparing the application independently or with the help of specialists.

1. Submitting to Ukrpatent the application or the document confirming payment of the filing fee.

2. Submitting to Ukrpatent the applicant's request for a substantive (qualification) examination of the application and the document confirming payment of the relevant fee.

3. After receiving the decision to grant a patent, submitting to Ukrpatent the document confirming payment of the state duty for issuance of the patent.

The patenting procedure with a substantive (qualification) examination takes on average about 30 months and is very complex. The cost of patenting consists of expenses for:

– payment for work on preparing the application;

– payment of duties and fees for actions related to the protection of IP rights.

An application is a set of documents required for granting a patent. An application for an invention must relate to one invention or a group of inventions linked by a single inventive concept (unity of invention requirement). An application for a utility model must relate to one utility model.

The application is drawn up in Ukrainian and must contain:

– a request for the grant of a patent for an invention (utility model);

– a description of the invention (utility model);

– the claims of the invention (utility model);

– drawings (if referenced in the description);

– an abstract.

The document confirming payment of the fee must be submitted to Ukrpatent together with the application or within two months from the filing date. This period may be extended, but not for more than six months, provided that before its expiry a request for extension is filed and the corresponding fee is paid.

A Ukrainian patent for an invention is granted based on the results of a substantive (qualification) examination of the invention application, during which compliance with patentability requirements is established. A Ukrainian patent for a utility model is granted based on the results of a formal examination.

State registration of a patent for an invention (utility model) is carried out upon submission of documents confirming payment of the state duty for issuance and the fee for publication of information on the patent grant.

The patent is issued within one month after its state registration. Based on the decision to grant a patent, state registration of a patent for an invention (utility model) or an industrial design is performed by entering the relevant information in the Register. The form of the Register and the procedure for its maintenance are determined by the competent authority in the prescribed manner. The patent is issued by the authority within one month after state registration of the right to the invention (utility model) or industrial design.

A patent is issued to the person entitled to receive it. If several persons are entitled to receive the same patent, one patent is issued to them. The term of a patent is 20 years

for an invention and 10 years for a utility model, counted from the date of filing the application.

The patent owner has the right to:

– use the invention (utility model) at their own discretion, provided that such use does not infringe the rights of other patent holders;

– prevent unlawful use of the invention (utility model), including prohibiting such use;

– transfer ownership rights under an agreement to any person who becomes the successor in title;

– permit use of the invention (utility model) under a license agreement.

Rights arising from a patent take effect from the date of publication of information on its grant. A patent gives its owner the right to prohibit other persons from using the invention (utility model) without the owner's permission (except in cases where such use is not considered an infringement of the rights conferred by the patent). The patent owner may transfer, under an agreement, ownership rights to the invention (utility model) to any person who becomes the successor in title.

Obligations of the patent holder:

– payment of patent fees;

– good-faith exercise of the exclusive right arising from the patent (use of the invention, utility model, industrial design).

Limitations of the patent owner's rights are possible in the following cases:

– recognition of the prior user right (or subsequent user right) of a third party;

– use of patented objects as parts of vehicles temporarily present within the territory where the patent is valid;

– use of inventions in emergency situations or for personal purposes;

– one-time preparation of medicines in pharmacies by a doctor's prescription;

– use of the invention for scientific research or experiments on the invention;

– granting of compulsory licenses.

A prior user right arises if the following conditions are simultaneously met:

– two identical solutions were created independently as a result of independent creative work;

– the person claiming the prior user right used the identical solution in production or made substantial preparations for such use before the priority date of the invention;

– all of these actions were carried out in Ukraine.

If the invention has been created but not used, the right does not arise [5,6].

6.2 Rights to an Industrial Design

Ownership rights to an industrial design are confirmed by a patent. The procedure is simpler than for an invention. After the filing date is established, a formal examination of the application is carried out (whether it is an object of industrial property and whether it complies with the law). Based on the decision to grant a patent and upon submission of the document confirming payment of the state duty for issuance, information is published in the official bulletin of Ukrpatent. State registration of the patent takes place simultaneously with publication. Within one month after registration, the State Department issues the patent to its owner. The term of property rights is 15 years. A Ukrainian patent for an industrial design is valid only in the territory of Ukraine.

6.3 Legal Means of Individualization of Participants in Civil Turnover of Goods and Services

The development of market relations, expansion of the sphere and volume of material production, and changes in the socio-economic structure of the state have led to the introduction of such mechanisms in Ukraine's economy, manifested in intensified competition among business entities operating in the same or related industrial sectors. Under the influence of these factors, the importance and role of special identifying designations used by producers to distinguish and individualize themselves and the results of their activities are increasing – means of individualization of participants in civil turnover, goods, and services.

Under Ukrainian legislation, the legal means of individualization include the following IP objects:

– commercial (firm) name;

– trademark (mark for goods and services);

– geographical indication.

A common feature of these objects, which at the same time distinguishes them from other IP objects, is their purpose: they individualize participants in civil turnover, goods, and services. A commercial (firm) name individualizes the business entity itself, while trademarks and geographical indications individualize goods and services.

Legal protection of these industrial property objects is provided on the basis of:

– the Law of Ukraine «On Protection of Rights to Marks for Goods and Services»;

– the Law of Ukraine «On Protection of Rights to Indications of Origin of Goods»;

– departmental regulations.

Commercial (Firm) Name. A commercial (firm) name is a name or designation that identifies an enterprise of a natural person or a legal entity.

The use of a name or designation is prohibited if, in itself or in connection with its use, it contradicts public morality or public order and, in particular, may mislead trade circles or the public as to the nature of the enterprise designated by such a name.

The following are not allowed in a name:

– an indication that a foreign enterprise belongs to another country;

– indicating a legal form of the enterprise different from the actual one;

– identity or similarity with the name of another enterprise that is not currently used but is known to the public.

A commercial name must truthfully reflect the legal status of the business entity. This means it must include the legal entity's actual organizational-legal form (limited liability company, joint-stock company, etc.), its type (state, private, etc.), its type of activity (production, research, commercial), and the owner’s identity. Exclusivity of a commercial name means it must have distinctive features that prevent confusion with another commercial name; it must be new and different from existing commercial names. The right to a firm name may be terminated early at the request of the right holder, upon liquidation of the firm, or when the firm is transferred to another owner.

Trademark (Mark for Goods and Services). A trademark is any sign or any combination of signs suitable for distinguishing goods (services) produced (provided) by one person from goods (services) produced (provided) by other persons.

The conditions under which designations are recognized as trademarks and granted legal protection are determined by the Law of Ukraine «On Protection of Rights to Marks for Goods and Services». Protection is granted only to a mark that does not contradict public interests, principles of humanity, and morality.

A trademark may function as an independent commodity. Ignoring the procedure for obtaining rights to a trademark can cause substantial material and moral damage that may far exceed the costs of obtaining the protection document.

If an enterprise intends to operate seriously in the Ukrainian market, then after developing a trademark and before launching a large-scale advertising campaign, it should register the trademark in order to avoid potential harm.

Designations that may not receive legal protection include those that:

– lack distinctiveness;

– are commonly used as designations of goods and services of a certain type;

– indicate the type, quality, quantity, properties, purpose, value of goods and services, as well as the place and time of manufacture or sale of goods or provision of services;

– are deceptive or may mislead as to the goods, services, or the person producing/providing them;

– are generally used symbols and terms;

– depict state coats of arms, flags, and emblems; official names of states; emblems, abbreviated or full names of international intergovernmental organizations;

– official control, warranty, and assay marks, seals;

– awards and other distinctions.

The subject matter of a trademark may include words, letters, digits, images, colors, combinations of colors, and other combinations of such elements. In Ukraine, designations that cannot be represented graphically – such as sounds, light signals, and smells – cannot be trademark objects.

Subjects of trademark rights under Ukrainian law are natural persons and legal entities.

Trademark applications are filed with Ukrpatent. If, as a result of the substantive examination, the trademark designation is found to meet the requirements for legal protection, the applicant receives a decision on registration; after payment of the state duty for issuance of the certificate, information on its issuance is published in the official bulletin «Industrial Property», and the trademark is state-registered.

A certificate is issued within one month after state registration. The average period from application to issuance of the certificate is 20 – 22 months. The term of validity is 10 years (it may be renewed each time for another 10 years).

The certificate grants its holder the exclusive right to prohibit others from using the sign without the holder's consent, unless otherwise provided by law, namely:

– the registered sign for the goods and services listed in the certificate;

– the registered sign for goods and services related to those listed in the certificate, if such use may mislead as to the producer/provider;

– a designation similar to the registered sign for the goods and services listed in the certificate, if such designation and the sign may be confused;

– a designation similar to the registered sign for related goods and services, if such use may mislead as to the producer/provider, or if the designation and the sign may be confused.

The owner of the trademark certificate may renounce it by filing an application with the State Department. The certificate may be suspended due to non-payment of the renewal fee (payment is possible within 6 months but with a 50% surcharge), due to prolonged non-use (3 years), or if the certificate contains elements of an invention in the mark and includes a list of goods/services that were not included in the original application.

Within six months from the date of publication of information on the issuance of the certificate, any person may file an opposition with the Appeals Chamber against the issuance of the certificate. After this period, a trademark may be declared invalid only through court proceedings.

After the certificate is suspended (for three years), a competitor may register the trademark in their own name.

Geographical Indication. The place of manufacture of goods may indicate their special unique qualities and the special craftsmanship of people in a certain area. Overall, this affects the product's reputation, consumer demand, and price.

A geographical indication of origin is understood as the name of a country, settlement, locality, or other geographical feature used to designate a product whose specific properties are exclusively or mainly determined by natural and/or human factors characteristic of that geographical area.

Essential conditions for legal protection of a geographical indication are:

– the presence in the product of special properties valuable from the consumer's perspective, which increase competitiveness in the market of similar goods;

– the determination of these properties exclusively or mainly by natural factors (climate, water, soil, etc.) characteristic of the relevant geographical area;

– and/or by human factors (skills and craftsmanship of producers).

Subjects of IP rights to a geographical indication include producers of goods, consumer associations, and other persons specified by law.

The scope of protection is determined not only by the name of the geographical place but also by the product's (service's) characteristics.

The Law of Ukraine «On Protection of Rights to Indications of Origin of Goods» specifies the categories of persons entitled to register a qualified indication of origin. These include: persons or groups producing goods in the declared geographical place whose special properties, qualities, reputation, or other characteristics are linked to that place; consumer associations; and institutions directly related to the production or study of relevant products, manufacturing processes, or geographical areas.

A Ukrainian geographical indication may also be registered in other countries whose legislation provides for such registration. However, a mandatory condition for foreign registration is prior registration and obtaining the right to use the indication of origin in Ukraine.

State registration is carried out by the State Department for Intellectual Property. Protection is granted based on registration and is valid indefinitely from the registration

date. The state is the owner of the geographical indication; it realizes its right by granting the right to use the object to other persons. This right, after registration, is valid for 10 years.

The certificate holder has the right to:

– use the registered indication of origin;

– take measures to prevent unlawful use of the geographical indication by persons who are not entitled to it;

– demand cessation of infringements and compensation for material and moral damage in accordance with the law.

The certificate holder does not have the right to:

– issue a license to use a geographical indication;

– prohibit competent authorities from carrying out control over the presence in goods of special properties and other characteristics on the basis of which the right to the geographical indication is registered [4-6].

6.4 Legal Protection of Non-Traditional IP Object

Non-traditional IP objects are results of intellectual, creative activity used not only in industry but also in other spheres of human activity.

They include:

– scientific discovery;

– layout design (topography) of an integrated circuit;

– rationalization proposal;

– plant variety, animal breed;

– trade secret.

Features of non-traditional IP objects:

– each such object has a creative character, i.e., it must be created as a result of activity that produces material or spiritual value;

– it must be expressed in any objective form;

– it requires appropriate legal regulation.

Protection of rights to non-traditional IP objects is regulated by the Civil Code of Ukraine; and for such objects as plant varieties and integrated-circuit topographies – by special laws: «On Protection of Rights to Plant Varieties» and «On Protection of Rights to Topographies of Integrated Circuits».

Scientific Discoveries. A scientific discovery is the establishment of previously unknown but objectively existing regularities, properties, and phenomena of the material world that bring fundamental changes to the level of scientific knowledge.

Objects of discoveries include regularities, properties, and phenomena of the world, divided into:

1. Regularity – a previously unknown objectively existing relationship between phenomena or properties of the material world that fundamentally changes the level of knowledge.

2. Property – a previously unknown objectively existing qualitative aspect of an object of the material world that fundamentally changes the level of knowledge.

3. Phenomenon – a previously unknown objectively existing form of manifestation of the essence of an object of the material world (nature) that fundamentally changes the level of knowledge.

Subjects of IP rights to a scientific discovery include the participants of the inventive process described below. The primary subject is the author. An author is a natural person who, through observation, research, experiment, or reasoning, independently made a scientific discovery in a manner ensuring its establishment. If several persons jointly fulfilled these requirements, any reference to the author is regarded as a reference to all such persons.

Co-authors are natural persons whose creative work established the discovery. Co-authors may include scientists where one discovered a previously unknown phenomenon and another provided scientific justification.

Heirs: after the author’s death, rights to the scientific discovery pass to heirs by law or by will. Heirs become full holders of all property rights belonging to the deceased author.

If the discovery is made in connection with the performance of an official assignment, all author’s rights are recognized as belonging to the specific developer.

Currently, in Ukraine, state examination, registration, and legal protection of discoveries are not carried out. There is a public organization – the Association of Authors of Scientific Discoveries of Ukraine – which registers applications, issues diplomas, and publishes information in a relevant Register.

Layout Design (Topography) of an Integrated Circuit. A layout design (topography) of an integrated circuit is a special IP object representing a spatial-geometric arrangement of the set of elements of an integrated circuit and the connections between them fixed on a material medium. These rights are protected by the Law of Ukraine «On Protection of Rights to Topographies of Integrated Circuits».

An integrated circuit topography is the spatial-geometric placement of the set of elements of the integrated circuit and connections between them fixed on a material medium.

The protection document confirming registration and ownership is a certificate. Registration is carried out by entering the topography into the State Register of Ukraine of integrated circuit topographies. The certificate is valid for 10 years from the filing date or from the first use date of the topography.

An integrated circuit topography cannot be considered an industrial design because it defines not the external appearance of the integrated circuit, but the mutual arrangement of elements and connections. Methods and technologies for manufacturing integrated circuits and crystal designs may be recognized as an invention or utility model if they meet patentability criteria, but not always—often due to lack of inventive step.

The main protectability condition is originality. A topography is original if it is not created by direct reproduction (copying) of another topography, has differences giving it new properties, and was not known in microelectronics before the filing date or before first use.

Subjects of rights to an integrated circuit layout design include:

– the author;

– other persons who acquired rights by contract or by law (employer; customer – rights belong jointly unless otherwise stipulated; successors such as heirs and other transferees).

Rationalization Proposal. A rationalization proposal is a reasonable proposal aimed at improving production processes. It is a proposal recognized by a legal entity that contains a technological (technical) or organizational solution in any sphere of its activity. The source of protection is the «Temporary Regulation on Legal Protection of Industrial Property Objects and Rationalization Proposals».

Objects of a rationalization proposal include a material object or a process. Criteria:

– technical or organizational solution;

– local novelty (unknown at the specific enterprise);

– usefulness.

Subjects:

– the author or co-authors (not necessarily employees of the enterprise);

– the legal entity to which the proposal is submitted and which recognized it.

The author has the right to fair encouragement from the legal entity. The legal entity has the right to use the proposal to any extent.

The author (co-authors) has the right to remuneration for two years from the start of use at the enterprise that issued the certificate. The remuneration amount is determined by contract and cannot be less than:

– 10% of the annual income obtained from use; or

– 2% of the share of product (works/services) cost attributable to the proposal when the useful effect does not influence income.

Plant Variety, Animal Breed. Selection is the breeding of new or improvement of existing breeds of domestic animals and plant species through artificial selection and cross-breeding. Modern selection includes three main areas: plant selection, animal selection, and microorganism selection. It is protected by the Law of Ukraine «On Protection of Rights to Plant Varieties».

The protection document is a patent. The patent term is 25 years from the application filing date; for tree and shrub varieties – 30 years.

Subjects include the author and other persons who acquired property rights by contract or law. To be recognized as an IP object, a plant variety must be protectable and meet criteria: novelty, uniformity, stability.

Trade Secret. A trade secret (know-how) is technical, commercial, organizational, or other information capable of increasing production efficiency or producing another positive effect. The object of IP rights is information that:

– is intangible (but stored and distributed using material carriers);

– provides a factual monopoly of a person over a set of knowledge;

– is unknown to third parties;

– establishes an exclusive subjective right to such information;

– has an unlimited protection term;

– does not require state registration or official recognition.

Despite its importance, there is no direct legal protection: currently, there is no separate Ukrainian law on know-how. The main obstacle is that know-how information, due to confidentiality, cannot be registered; therefore, no protection documents are issued. Detecting unlawful use is extremely difficult. Protection may be ensured by measures maintaining confidentiality; confidentiality conditions may be secured, for example, by contract.

Subjects of trade secret rights:

– a person who lawfully determined information to be a trade secret (this person holds full property IP rights under the Civil Code of Ukraine);

– persons who received the information based on a civil agreement (e.g., under a commercial concession agreement) or an employment agreement (employee), as well as public-law entities (state authorities or local self-government bodies) to whom it was provided, or who obtained it by another lawful method.

General Conclusion. The protection document for an invention (utility model) and an industrial design is a patent. Legal means of individualization of participants in civil turnover, goods, and services include: commercial (firm) name, trademark (mark for goods and services), and geographical indication. Non-traditional IP objects include: scientific discovery, integrated-circuit layout design, rationalization proposal, plant variety/animal breed, and trade secret.

Control Questions:

1. What decisions may an inventor, employer, or right holder make regarding legal protection of intellectual property?

2. Describe the procedure for obtaining a patent for an invention (utility model).

3. List the obligations of a patent holder.

4. What belongs to the legal means of individualization of participants in civil turnover of goods and services?

5. What is a firm (commercial) name?

6. What is the legal protection of a geographical indication?

7. What are the features of a rationalization proposal?

8. Which legal acts regulate IP rights to the layout design (topography) of an integrated circuit?

9. What is a trade secret?

10. What are the conditions for granting legal protection to a scientific discovery?

11. What constitutes the system of non-traditional IP objects?

12. Into what objects are the objects of a scientific discovery divided?

Topic 7. Contracts in the Field of Intellectual Property

7.1 General Provisions

Disposition (management) of intellectual property (IP) proprietary rights is carried out on a contractual basis.

A contract is an agreement on the emergence, change, or termination of the rights and obligations of persons.

The main contracts in the IP field are divided into:

1. Contracts for the creation of IP objects;

2. Contracts for the use of IP objects.

Disposition of proprietary IP rights may be carried out on the basis of the following

contracts:

3. A license to use an IP object;

4. A license agreement;

5. An agreement on commissioned creation and use of an IP object;

6. An agreement on the transfer (assignment) of exclusive proprietary IP rights;

7. Another agreement on the disposition of proprietary IP rights.

The elements of contracts in the IP field are:

a) the parties to the contract;

b) the essential terms of the contract:

– subject matter;

– price;

– term (duration);

– territory of validity/use;

c) the form of the contract.

The parties to a contract on the disposition of proprietary IP rights are the IP right holder (licensor, author, etc.) and the person wishing to use the IP object (licensee, заказник/customer, etc.).

The essential terms of a contract on the disposition of proprietary IP rights are: subject matter, price, term, and territory of use.

The subject matter of IP contracts is the proprietary IP rights to a work, performance, invention, utility model, industrial design, trademark, or another object. The content of the contract consists of the rights and obligations of the parties. All contract terms are divided into: essential, ordinary, and incidental:

1. Essential terms are all terms without which the contract has no legal force (e.g., the object of the contract, price, time limits, methods of use, amount and procedure for payment of royalties, etc.).

2. Ordinary terms are determined by standard contracts (place of performance/use, time of conclusion, liability for non-performance, etc.).

3. Incidental terms modify or supplement the contract conditions.

All such contracts must be concluded in writing. At the request of the parties, the contract may be notarized [6,7].

7.2 License and License Agreement

The parties to a license agreement are the licensor and the licensee.

A licensor is a person who holds exclusive proprietary IP rights (a person who holds proprietary copyright or the owner of a protection document for an invention, utility model, industrial design, trademark, layout design of semiconductor products, or a plant variety).

A licensee is a person who has been granted permission to use an IP object (a license).

A person who has the exclusive right to authorize the use of an IP object (the licensor) may grant another person (the licensee) written authorization that entitles the licensee to use the object within a specific limited scope. A license to use an IP object may be prepaired as a separate document or may form part of a license agreement.

The difference between a license and a license agreement is that a license is a document that allows the licensee to use an industrial property object, while the subject matter of a license agreement is the license (the right) granted to the licensee to use the IP object under conditions agreed by the parties, taking into account the requirements of the Civil Code of Ukraine and other laws.

A license agreement must clearly define all conditions of use, the scope (scale) of use, conditions for termination, and liability provisions.

The Civil Code defines the following types of licenses:

– exclusive – granted to only one licensee; it excludes the licensor's use of the IP object within the licensed field and also excludes granting licenses to others in that field;

– sole – granted to only one licensee; it excludes granting licenses to others in that field, but does not exclude the licensor's own use within the agreed field;

– non-exclusive – does not exclude the licensor's own use within the licensed field and does not exclude granting licenses to others in that field;

– sublicense – written authorization by the licensee (with the licensor's consent) for a third party to use the IP object.

A full license is permission to use a patented object for the entire term of the patent and to use the object in full scope.

An open license means that the patent (certificate) owner for an industrial property object (except patents for secret objects) has the right to file with the State Department, for official publication, a заяву indicating readiness to grant any person permission to use the patented object.

A compulsory license may be granted (through a court) if an industrial property object is not used without valid reasons for three years from the date of publication of the grant of the protection document, or from the date when use ceased.

When concluding a license agreement, it should be taken into account that:

– the subject matter cannot be rights to use an object of copyright and related rights that has not yet been created;

– rights and methods of use not specified in the agreement are considered not granted to the licensee;

– if the agreement does not specify the territory, the license applies to the entire territory of Ukraine;

– if remuneration for publishing or other reproduction of a work is set as a fixed sum, the agreement must specify the maximum print run;

– the term of the agreement must not extend beyond the validity term of the exclusive proprietary right to the object specified in the agreement;

– if the agreement does not specify a term, it is deemed concluded for the remaining term of validity of the exclusive proprietary right, but not more than five years.

If, six months before the end of the five-year term, neither party notifies the other in writing of delay, the agreement is considered extended for an indefinite period. In this case, either party may terminate the agreement at any time by giving written notice six months before termination, unless a longer notice period is agreed.

The licensor may terminate the license agreement before its expiry if the licensee violates the contractual deadline for commencing use of the IP object. Either party may terminate if the other party breaches other contractual terms.

A license agreement is not subject to mandatory state registration. However, such registration may be carried out for a license agreement and other rights to the relevant IP object [7].

7.3 Agreement on Commissioned Creation and Use of an IP Object

An author's contract is a contract under which the author transfers or undertakes to transfer to another party the rights to use a work within the scope and on the conditions agreed by the parties.

Under an agreement on commissioned creation and use of an IP object, one party (the creator – writer, artist, etc.) undertakes to create an IP object in accordance with the requirements of the other party (the orderer/customer) within a specified time.

This agreement is concluded before the IP object is created, for the purpose of its subsequent use. As a rule, it is applied within the copyright system.

Author's contracts are divided into:

– contracts for the creation of works of science, literature, or art;

– contracts for the use of such works.

An author's contract must provide for:

– methods of use of the work (the specific rights transferred);

– the term and territory for which the rights are transferred;

– the amount of remuneration and/or the procedure for determining it, as well as the procedure and time limits for payment;

– other terms that the parties deem essential.

The essential terms of an agreement on commissioned creation and use of an IP object are:

– the subject matter to be created or used;

– methods and conditions under which the customer will use the object.

Personal non-proprietary IP rights to an object created on commission belong to the creator of that object. However, in cases provided by law, certain personal non-proprietary rights may belong to the customer. Proprietary IP rights to an object created on commission belong to the creator of that object.

7.4 Agreement on the Transfer of Exclusive Proprietary IP Rights

An agreement on the transfer of exclusive proprietary IP rights is a contract under which one party (the holder of exclusive proprietary rights) transfers to the other party, partially or in full, these rights in accordance with the law and under conditions determined by the contract (Part 1, Article 1113 of the Civil Code).

When such an agreement is concluded, the rights are alienated, i.e., transferred irrevocably. Therefore, the recipient of the exclusive proprietary rights becomes the successor in title and assumes all rights and obligations regarding the IP object.

The parties to the agreement are the author of the work or another rights holder (including the owner of rights). The holder of exclusive proprietary rights may be not only a natural person but also a legal entity that acquired these rights by contract or otherwise. The other party may be any natural person (with appropriate civil capacity) or any legal entity.

The subject matter of such an agreement may include only exclusive proprietary rights that exist at the time of concluding the agreement.

Exclusive proprietary IP rights in science are the monopoly right to use a work in any form and by any method that does not contradict the law.

According to Part 1, Article 1114 of the Civil Code of Ukraine, an agreement on the transfer of exclusive proprietary IP rights is not subject to mandatory state registration; however, Part 2 of the same article states the mandatory state registration of the fact of transfer of rights to IP objects. Registration of the fact of transfer of exclusive proprietary IP rights that are valid after state registration is carried out on the basis of the agreement on transfer of exclusive proprietary rights [5-7].

7.5 Other Agreements on the Disposition of Proprietary IP Rights

An agreement on the transfer of know-how is a contract under which the rights holder transfers to interested persons the right to use, in whole or in part, confidential

knowledge that includes technical, production, administrative, and financial information, the use of which provides certain advantages to the recipient.

Know-how is fully or partially confidential knowledge, including technical, production, administrative, and financial information, the use of which provides certain advantages to the person receiving it.

Often, such information could be patented (e.g., as an invention or utility model), but in each specific situation the rights holder decides whether to disclose it and obtain a protection document or whether it is more appropriate to keep it secret. A clear example is the secret formula of Coca-Cola. If it had been patented, it would now be in the public domain and could be freely used. Since the subject matter of a know-how transfer agreement is secret knowledge, one mandatory condition is maintaining confidentiality of the received information.

An agreement on the procedure for distributing rights to employee-created (service) IP objects is a civil-law contract concluded between an employer and an employee to coordinate rights to creative results produced in connection with performance under an employment contract.

If there is no such agreement, the general rule applies: proprietary IP rights to an object created in connection with performance under an employment contract belong jointly to the employee who created it and to the legal entity or natural person for whom the employee works (Civil Code of Ukraine, Part 2, Article 429).

A similar rule applies to the distribution of IP rights to an object created on commission. It is advisable for the parties to regulate their rights in more detail in the contract, because the general rule of joint ownership may complicate relations in the future if the employee and employer cannot reach agreement. From a legal standpoint, the ideal situation is when only one subject holds rights to the object, as this simplifies realization of rights.

IP subjects may also conclude other agreements concerning IP objects. The main requirement is that their terms must not contradict the mandatory provisions of Ukrainian civil legislation.

General Conclusion. Agreements on the disposition of proprietary IP rights are a group of contracts in the IP field aimed at acquiring, changing, or terminating proprietary

rights to IP objects. A license agreement is a contract under which one party (the licensor) grants the other party (the licensee) permission (a license) to use an IP object on terms agreed by the parties in accordance with legislation. Other IP contracts include a know-how transfer agreement, an agreement on the distribution of rights to employee-created IP objects, and others.

Control Questions:

1. Provide a general description of contracts in the field of intellectual property.
2. Name the main contracts in the IP field.
3. What is the subject matter of contracts in the IP field?
4. Define the term «licensor».
5. What is a license?
6. Define the term «license agreement».
7. What types of licenses exist?
8. What is meant by «know-how»?

Topic 8. Commercialization of Intellectual Property Objects

8.1 The Intellectual Economy

Intellectual property, understood as legally protected results of a person's intellectual work, can directly participate in the creation of added value and therefore be considered an economic category. Moreover, intellectual property is most often created precisely to contribute to added value and to bring additional profit to its owner.

The intellectual economy is a field of knowledge that studies the theory and practice of the functioning of market structures and the mechanisms of interaction among economic actors related to intellectual capital.

Business is a type of activity aimed at generating income as a result of the commercialization of an intellectual product.

Intellectual capital is knowledge that can be transformed into profit and can be valued. Commercialization of intellectual property objects is a set of mutually beneficial (commercial) actions by all participants in the process of transforming the results of intellectual work into a marketable product in order to obtain profit or another market benefit. The purpose of commercialization of IP objects is to generate profit through the use of IP objects in one's own production, or through the sale or transfer of rights for their use to other legal entities or individuals.

The main methods of commercialization of IP rights are:

– use of IP objects in one's own production;

– contribution of rights to IP objects to the authorized (share) capital of an enterprise;

– transfer (sale) of rights to IP objects.

It is considered that commercialization through the use of IP objects in one's own production is the most profitable from the standpoint of revenue. This is because all profit from selling an innovative product created with the help of IP objects remains with the owner of the IP object. Since production volumes may be large, the resulting profit may exceed many times the value of the rights to the IP object in cases where rights are merely transferred for use or sold.

If the rights holder does not intend to use the IP object in their own production, start a new business, or establish a joint venture, they may fully or partially transfer ownership rights to the IP object to another individual or legal entity. Intellectual property may be contributed to the authorized capital instead of property, money, or other material assets, which requires the goodwill of all founders.

Using intellectual property in the authorized capital makes it possible to:

– form a substantial authorized fund without diverting financial resources and gain access to bank loans and investments by using IP as collateral on par with other types of property;

– amortize intellectual property in the authorized capital and replace it with real funds by including depreciation charges in the cost of production, i.e., capitalize intellectual property;

– enable authors and enterprises that own IP to become founders (owners) when establishing subsidiary or independent enterprises without withdrawing cash resources [7,8].

8.2 Valuation of Intellectual Property Rights

The legal basis for valuing IP rights in Ukraine is the Law of Ukraine «On Valuation of Property, Property Rights and Professional Valuation Activity in Ukraine» dated 12 July 2001, No. 2658-III.

Valuation sequence. Determining the value (price) of rights to an IP object is one of the necessary, responsible, and complex stages of commercialization (Fig. 5). Before starting the valuation, it is necessary to determine what exactly is being valued:

– rights to an invention;

– a technology;

– a trademark;

– a trade secret.

Valuation of the value of rights to an IP object is carried out in order to determine:

– identification of the IP object;

– determination of the purpose of the valuation;

– selection of an approach to valuation;

– selection of a valuation method;

– calculation of the value of the IP object.

The need to value intellectual property also arises in cases of:

– contributing it to innovation and investment projects;

– expanding sales markets;

– insurance;

– using IP as collateral to obtain loans;

– determining damages caused by unlawful use of an IP object;

– bankruptcy of an enterprise during liquidation in order to satisfy creditors' claims.

8.3 International Patenting of Intellectual Property Objects

It is important to note that a patent obtained in Ukraine provides patent protection only within the territory of Ukraine.

To obtain a patent for an invention or industrial design not only in one's own country but also abroad, several systems exist: the traditional system, the regional system, and the PCT system (under the Patent Cooperation Treaty) for inventions, as well as the international protection procedure for industrial designs under the Hague Agreement. The Hague Agreement concerning the international deposit of industrial designs helps simplify the procedure for obtaining protection for an industrial design in a number of countries. This system enables the owner of an industrial design to obtain protection for the design in many countries by submitting a single application in one language to the International Bureau, provided that a single set of fees is paid in one currency (Swiss francs). It has the effect of a properly filed national application in each of the countries that are members of the Hague System.

The system also significantly simplifies subsequent actions related to an industrial design, since major changes can be recorded or the deposit can be renewed through a single procedural step at the International Bureau.

The main prerequisites for obtaining legal protection (patenting) abroad are:

– ensuring industrial exports, i.e., protecting exports when shipping domestic industrial goods, supplying equipment abroad, or building enterprises based on Ukrainian documentation and technical support from Ukrainian organizations;

– ensuring better conditions for selling licenses to foreign companies for the right to use domestic inventions;

– creating a joint venture abroad in which the Ukrainian side contributes rights to inventions and other achievements as an investment;

– scientific and technical cooperation with a foreign company resulting in independent and joint developments.

The essence of the traditional system is that an applicant who wishes to obtain a patent in several countries files patent applications in each country separately. In doing so, the applicant must comply with the formal requirements of each country (the application must be in the language of the specific country, correspondence with each Patent Office must be conducted through patent attorneys, and the prescribed fees must be paid in each country, etc.).

Protection of a trademark in other countries can be obtained in two ways. First, an application may be filed with the office of the country where protection is desired according to the laws and rules governing trademark registration in that country. Second, the mark may be registered in foreign states under the Madrid Agreement concerning the international registration of marks or the Protocol to that agreement. In this case, an application indicating the list of countries in which protection is sought is submitted to Ukrpatent. The procedure for filing an application for international registration under the Madrid Agreement is defined in the Rules [6-8].

General Conclusion. The intellectual economy is a field of knowledge that studies the theory and practice of the functioning of market structures and the mechanisms of interaction among economic actors related to intellectual capital. The purpose of commercialization of IP objects is to obtain profit through the use of IP objects in one's own production, or through the sale or transfer of rights for their use to other legal entities or individuals.

Control Questions:

1. Define the term «intellectual economy».

2. Define the term «business».

3. What is the commercialization of intellectual property objects?

4. Name the main methods of commercialization of IP rights.

5. Provide the sequence for valuing an IP object.

6. Describe the features of international patenting of intellectual property objects.

Literature

1. Zlotenko B., Kulik T. I. Methodology of Modern Scientific Research with the Basics of Intellectual Property. Kyiv. Kyiv National University of Technologies and Design, 2021. 155 p.

2. Naim N. (Ed.). Developments in Intellectual Property Strategy: The Impact of Artificial Intelligence, Robotics and New Technologies. Cham. Palgrave Macmillan, 2024. 196 p.

3. Naim N., AlDebasi A., Price D. (Eds.). Intellectual Property and Innovation: Contemporary Developments in the GCC Member States. Singapore. Palgrave Macmillan, 2024. 265 p.

4. Kongolo T. Intellectual Property and Emerging Technologies: Generated Global IP Issues and Challenges. London. Routledge, 2024. 146 p.

5. Pick B. Intellectual Property and Development: Geographical Indications in Practice. London. Routledge, 2024. 192 p.

6. Lombardi E. M. Digitization, Copyright and the Law: Copyleft and the Future of Intellectual Property. London. Routledge, 2024. 210 p.

7. World Intellectual Property Organization (WIPO). World Intellectual Property Indicators 2024. Geneva. WIPO, 2024. 236 p.

8. Beltrán-Urvina L. I. Intellectual Property as a Strategy for Business Development. Laws. 2025. Vol. 14, No. 2. P. 1–18.

FOR NOTES

F -97 Scientific Research in the Field and Intellectual Property. Lecture Notes for Students of the Second (Master's) Level of Higher Education in the Field of Knowledge G – Engineering, Manufacturing and Construction, Specialty G5 – Electronics, Electronic Communications, Instrument Engineering, and Radio Engineering, EP «Electronics» and «Telecommunications and Radio Engineering», for all forms of study. Compiled by M. Khvyshchun, V. Lyshchuk. Lutsk: LNTU, 2026. 80 p.

Typesetting Mykola Khvyshchun
Editor Mykola Khvyshchun

Signed for printing: «__» _____ 2026
Format: 60×84/16. Offset paper.
Font: Times New Roman. Printed sheets: 4.
Print run: 50 copies

Image and Promotion Department
Lutsk National Technical University
75 Lvivska Street, Lutsk, 43018,
UkrainePrinting – VIP LNTU