Recommended
at the meetings of the Department of Automation and Computer Telecommunications by Hand

protocol № 9 dated 04.07.2022

SYLABUS

from the discipline **«Fundamentals of Scientific Research»**

Semester and year of study:	***I semester, first year of study***
Educational level:	***second (master's)***
Branch of knowledge	***15 – Automation and instrumentation***
Code and name specialty	***151 Automation and computer-integrated technology***

Lectures, practical classes according to the schedule http://rasp,kart.edu.ua

Teaching team:

Lecturer: ***Koshevyi Serhiy Vasyliovych***, associate professor of the Department of Automation and Computer Telecontrol of Train Traffic (AT)

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Reception and consultation hours: every Thursday, 14.10 – 15.30

Location of the department (teaching): City of Kharkiv, Feuerbacha Maidan, 7, 1st building, 2nd floor, 222 auditorium.

Web pages of the course: http://do.kart.edu.ua/

Additional information materials: http://metod.kart.edu.ua

Kharkiv - 2022

1. Abstract of the discipline

The purpose of teaching the discipline "Fundamentals of Scientific Research" (FSR) is to prepare students for independent scientific research, creative participation in the development, design, construction, operation of devices of railway automation and traffic control systems ", for which it is necessary:

– to acquaint students with the essence of science, its organization and importance in modern society;

– to equip future specialists, scientists with knowledge of structure and basic methods of scientific research, including methods of theory of similarity, modeling, etc.;

– teach planning and analysis of the results of experimental research.

The main tasks of studying the discipline of the FSR are the study of theoretical and empirical methods of scientific research, as well as to obtain practical activity in the development, design, construction, operation of railway automation devices and control systems.

The discipline of the FSR is the basic for the implementation of diploma design on the topic of construction of railway automation systems at stations, races, onboard systems of management and safety of train traffic, project protection in the State Examination Commission (SEC).

The course aims to form and develop the following masters competences:

Integral – the ability to solve complex specialized tasks and practical issues in the field of current operation, maintenance and repair of traffic management systems or in the process of further training, which involves the use of theories and methods Sciences and is characterized by complexity and uncertainty of conditions.

Research, methodological skills – the ability to think, analysis and synthesis of technological processes, phenomena, mechanisms, understanding of their cause and effect relationships. The ability to conduct scientific research in professional activity and/or innovative activity, the ability to generate new ideas.

Interpersonal interaction – the ability to work in a team, to conduct scientific discussions, to convince and influence other participants in group processes, to demonstrate a wide range of cognitive, legal and intellectual skills for the purposes of effective functioning of traffic management systems, intellectual property protection; the ability to communicate and cooperate with experts in other industries, to adapt in the social and professional environment.

Professional (organizational and technological) skills – the ability to use the acquired knowledge to develop, design and introduce technical documentation, instructional instructions, rules and methods of development and implementation repair and maintenance of devices and control systems of trains movement

Information and technological skills – the ability to search, process and analysis of information, development and implementation of information systems, identification and use of optimal software in professional activity;

Forecasting skills – the ability to identify problems, to set strategic goals, to forecast the development of technological and economic processes, phenomena and mechanisms, to analyze technological processes of production and repair of devices and control systems of trains as an object Functioning of the enterprise with assessment of the quality of its products.

Estimated skills – the ability to use methods of planning, design, modeling, control, strategic analysis of technological and economic events, phenomena and mechanisms.

Deep knowledge and understanding – the ability to develop models, to analyze and structure technological and economic events and phenomena in terms of knowledge of modern theoretical, organizational and methodological bases of construction and functioning of systems of trains movement; the ability to apply mathematical and statistical methods in collecting, systematization, generalization and processing of scientific and technical information, preparation of reviews, annotations, preparation of abstracts, reports and bibliography on research objects; to participate in scientific discussions and procedures for the protection of scientific works of different levels and speeches with reports and reports on the subject of research; have ways to spread and promote professional knowledge; The ability to take an active part in research and experiments, to analyze, interpret and model on the basis of existing scientific concepts individual phenomena and processes in professional activity with the formulation of reasoned conclusions.

2. Why do you have to choose this course?

Modern production requires specialists the ability to independently ask and solve various fundamentally new issues, which cannot be done without students' mastering the basics of scientific research.

The purpose of teaching the discipline of the FSR is to prepare students for independent research, creative participation in the development, design, construction, operation of railway automation devices and traffic control systems ", which is necessary for:

– to acquaint students with the essence of science, its organization and importance in modern society;

– to equip future specialists, scientists with knowledge of structure and basic methods of scientific research, including methods of theory of similarity, modeling, etc.;

– teach planning and analysis of the results of experimental research.

According to the requirements of the educational and professional program, students should:

know:

– methodology and basic methods of theoretical and experimental scientific research;

– planning and organization of research;

– sources of information for scientific research;

– basic methods and stages of design of scientific results;

– the main stages of patent work;

be able:

– to search and analyze the necessary information on the topic of scientific research;

– develop theoretical hypotheses, plan and experiment process the results of tests and measurements;

– compare the results of the experiment with theoretical assumptions;

– formulate the conclusions of scientific research;

– report, article, scientific report on the results of scientific research and conduct a discussion when discussing scientific results;

have an idea:

– on problems and directions of development of technical equipment of railway automation and computer control systems on railway transport.

to find and analyze the necessary scientific information in the field of modeling and construction of structures of automation of control processes and ensuring safe train movement;

be able to discuss scientific conferences and symposia and present their own projects or qualification work as a coherent structure.

to acquire systematic creative thinking about generating possible ideas or approaches in the process of research and modeling of methods and structure of hardware and software tools to ensure train safety.

The team of teachers will be ready to provide any assistance with the most complex aspects of the course by e-mail and personally-during working hours.

3. Description of the discipline

The discipline "Fundamentals of Scientific Research", which takes 120 hours / 4,0 credits of ECTS during the semester (1st semester) gives the undergraduates a deep understanding Conducting theoretical and experimental research, their information support, search, accumulation and processing of scientific and technical information, processing and use of research results.

Fundamentals of Scientific Research / Course Scheme

Think about it	Lectures	
	Practical training	
	Independent work on remote study at the PC of theoretical part of the course	
	Reference material	
	Movies and presentations	
	Discussion in the audience	**Execute**
	Assistance in performing qualification graduation work (the diploma project)	
	Individual consultations	
	On-line Discussion (Forum in the Moodle web environment, social networks)	
	Test	

The course consists of 15 hours of lectures, 15 hours of practical classes during one semester. It is accompanied by textual material, presentations. Types of control - two modular test tasks and credit. The course web resource developed on the Moodle platform at do.edu.kart.ua (undergraduates will be able to apply the acquired knowledge and solve practical problems by discussing in the audience during practical classes.

The discipline has the following control measures:

– twice after two training modules - passing test control determination of quality of training;

– the final stand after the semester is completed.

4. Course resources

The course information is posted on the website of the University http://do.kart.edu.ua/ (including the necessary methodological materials, presentations, films, test tasks for individual content modules and rules of course evaluation) in the

section "Distance learning". The necessary preparation should be completed before the lecture or practical class. The discussion proposes an analysis on the role of scientific research in society and the creation of the latest technologies and prospective systems and devices on railway transport, planning and forecasting of scientific research, organization of scientific work, classification and stages of research, methods of theoretical and empirical research, methods Elements of theory and methodology of scientific and technical creativity, etc.

Examples of discussion issues:

– determination of science, its purpose and components; concepts, facts, categories, principles, scientific laws, theory; methods and methodology of research;

– planning and forecasting of scientific research, organization of scientific work;

– classification and stages of research work;

– methods of theoretical and empiric studies;

– the main directions of development of technical means of railway automation and computer control systems on railway transport and problems that arise when they are created;

– technical and economic justification of research works.

– basic sources of scientific and technical information, methods of search, analysis and processing of scientific and technical information;

– modeling in scientific research, types of models;

– use of computers in scientific research;

– analysis of scientific research, formulation of conclusions and proposals, preparation of reports on research work;

– preparation of scientific materials for printing, features of publication of scientific articles, collections of works and monographs;

– introduction of research work in production, efficiency of research and its criteria;

– creative process and legal protection of its results, registration of patent rights, exercise of patent rights, copyright;

– calculation of economic efficiency of scientific research.

Undergraduates can ask questions, as well as discuss and analyze the topics of discipline outside of lectures.

5. Distribution of lectures into content modules

Content module 1. **General information about science and research**

Topic 1. Basic concepts and definitions

Topic 2. Organization of scientific activity. General characteristics and methodological foundations of scientific research.

Topic 3. Choosing the direction of scientific research. Information support of scientific research. Search, accumulation and processing of scientific and technical information

***Content module 2*. Theoretical and experimental studies**

Topic 4. Theoretical research and methods of their conduct

Topic 5. Experimental research and processing of their results

***Content module 3*. Processing and use of research results**

Topic 6. Analysis and design of research results. Legal Support for Scientific Research

Theme 7. Copyright concept

Topic 8. Implementation and effectiveness of research. Stages of development of development

6. Practical classes

№ i.o.	Topic name
PC 1	Analysis of problems of development of technical means of CJSC.
PC 2	Classification and structure of theoretical research.
PC 3	Application of mathematical and simulation models in scientific activity.
PC 4	Statistical processing of experimental data.
PC 5	The main stages of the GDR. Choice of scientific research.
PC 6	Use in scientific research of regulatory documentation. Patent search, accumulation and processing of scientific and technical information. Drawing up applications for inventions.
PC 7	Methods of calculation of technical and economic efficiency from the implementation of GDR results.
PC 8	Requirements for the design of the GDR report.

7. Independent work

№ i.o.	Topic name
1	Study of lecture material on electronic lecture notes, textbooks, manuals, distance training course.
2	Preparation for practical classes.

8. Planned Learning Results (LO)

Integral competence, general competence (GC), special (professional) competence (SC) are planned.

1) Integral competence: the ability to solve complex tasks and problems of automation and computer-integrated technologies in professional activity and/or in the learning process, which involves conducting research and/or conducting innovation activity and is characterized by the complexity and uncertainty of conditions and requirements.

2) General competences:

– GC1. The ability to conduct research at the appropriate level;

– GC2. The ability to generate new ideas (creativity);

– GC3. Ability to abstract thinking, analysis and synthesis;

– GC4. The ability to work in an international context.

3) special (professional, subject) competences:

– SC2. The ability to design and implement high -reliable automation systems and their applied software, to implement the functions of management and information processing, to protect intellectual property rights for new design and engineering solutions;

– SC3. The ability to apply modeling and optimization methods to research and increase the efficiency of systems and processes of control of complex technological and organizational-technical objects

– SC4. The ability to analyze production and technological systems and complexes as automation objects, to determine the methods and strategies of their automation and digital transformation;

– SC5. The ability to integrate knowledge from other fields, apply a systematic approach and take into account non -technical aspects in solving engineering tasks and conducting research;

4) additional special competences to the program of educational and scientific

training of masters:

– SC9. The ability to apply modern technologies of scientific research of processes, equipment, tools and systems of automation, control, diagnostics, testing and management of complex organizational and technical objects and systems;

– SC10. The ability to identify the scientific essence of problems in the professional field, to plan and carry out appropriate scientific and applied research;

– SC12. The ability to present the results of research activities, to prepare scientific publications, to participate in scientific discussion at scientific conferences, symposia and to carry out pedagogical activity in educational institutions;

– SC14. The ability to rationalize in the field of automation and computer-integrated management of technological processes in various fields.

Planned learning outcomes (LO):

LO02	Create high -level and safe automation systems with high levels of functional and information security of software and technical means complex tasks of professional activity.
LO03	Apply specialized conceptual knowledge that includes modern scientific achievements, as well as critical comprehension of modern problems in the field of automation and computer-integrated technologies for solving.
LO04	Apply modern approaches and methods of modeling and optimization to research and create effective automation systems with complex technological and organizational and technical objects.
LO05	Develop computer-integrated management systems of complex technological and organizational and technical objects, applying a systematic approach taking into account non-technical components of assessment of automation objects.
LO07	Analyze production and technical systems in a particular field of activity as objects of automation and determine the strategy of their automation and digital transformation.
LO11	Adhere to the norms of academic integrity, know the basic legal norms for the protection of intellectual property, commercialization of the results of research, inventive and project activities.
LO12.	Collect the necessary information, using scientific and technical literature, databases and other sources, analyze and evaluate it.
LO13	Apply modern scientific research technologies, specialized mathematical tools for research, modeling and identification of automation objects.
LO14	Be able to identify the scientific essence of problems in the professional field, find ways to solve them.
LO15	Apply methods of analysis, synthesis and optimization of cyberphysical industries, systems of automation of production management, product life cycle and its quality.
LO16	Plan and perform scientific and applied research in the field of automation and computer-integrated technologies, choose effective research methods, argue conclusions, present research results.
LO17	To draw up and submit rationalization proposals, to introduce their results into production.

9. Evaluation rules

When filling out the examination report and scorebook (individual study plan) of the master's student, the grade given on a 100-point scale must be converted to the

national scale (excellent – 5, good – 4, satisfactory – 3, unsatisfactory – 2) and the ECTS scale (A, B, C, D, E, FX, F).

Determination of the name according to the state scale (estimation)	Determination of the title according to the ECTS scale	On a 100-point scale	ECTS assessment
Excellent – 5	**Excellent** – excellent performance with only a few minor errors	90-100	A
Good – 4	**Very good** – above average with a few errors	82-89	B
	Good – generally correct work with a certain number of gross errors	75-81	C
Satisfactory – 3	**Satisfactory** – not bad, but with a significant number of shortcomings	69-74	D
	Sufficient – performance meets minimum criteria	60-68	E
Unsatisfactory – 2	**Unsatisfactory** – you need to work before getting credit (without re-studying the module)	35-59	FX
	Unsatisfactory – serious further work is required (re-study of the module)	<35	F

Visiting lectures. The points for this component are not accrued at all if the undergraduate did not attend more than 50 % of the lecture classes in the module without good reason. The maximum amount is 15 points.

Practical training. They are evaluated for attendments. The maximum amount is 15 points.

The degree of involvement. The purpose of participating in the course is to involve you in the discussion, to expand your learning opportunities for yourself and your partners, to give you another way to test your theoretical and practical knowledge of methods of scientific research to achieve the efficiency of use and safety Methods for the organization of communication channels and information exchange between stationary and on -board SAR devices, impact on the safety of trains of information support of SAR systems, achievement of SAR devices for electromagnetic compatibility requirements. Questions, although encouraged, are not evaluated in this block. We try to give all students equal and fair opportunities to increase their own involvement. The maximum amount is 30 points.

Final modular test. The maximum amount is 40 points.

Test. The student receives an assessment on the basis of current control by accumulating points. The maximum number of points that a student can receive is 100 (up to 60 points of current control and up to 40 points during final modular testing). If the student does not agree with the points offered, he or she can increase them on the exam by answering the examination of the examination.

10 Means of Diagnosis of Training Performance

1. Oral current survey in lectures, practical classes.
2. System of knowledge control by the PC testing method while working on a distance learning course.
3. System of knowledge control system by PC testing during modular control.
4. A written answer to the question of the credit of the theoretical question and task on the standings (if necessary at the initiative of the undergraduate).

11. Code of Academic Integrity

Violation of the Code of Academic Integrity of the Ukrainian State University of Railway Transport (USURT) is a serious violation, even if it is unintentional. The Code is available at: http://kart.edu.ua/documentu-zvo-ua.

In particular, the compliance with the USURT Academic Integrity Code means that all work on exams and tests should be carried out individually. When performing independent work, students can consult with teachers and other students, but should solve the tasks independently, based on their own knowledge, skills and skills. References to all resources and sources (for example, reports, independent work or presentations) must be clearly defined and properly designated. In the case of working together with other students on the accomplishment of individual tasks, you should indicate the degree of involvement in work.

12. Integration of students with disabilities

Higher education is a leading factor in raising social status, achieving spiritual, material independence and socialization of young people with limited functionality and reflecting the state of development of democratic processes and humanization of society.

To integrate students with disabilities into the educational process of the Ukrainian State University of Railway Transport, a system of distance learning was created on the basis of modern pedagogical, information, telecommunication technologies. Access to distance learning materials from this course can be found at: http://do.kart.edu.ua/ (the name of the course on the USURT tab - "Fundamentals of Scientific Research").

13 Recommended literature

Basic Literature on Theoretical Course

1. OV Kolesnikov Fundamentals of Scientific Research: A Textbook. - Kiev: "Center of Educational Literature". 2011. - 144 p.
2. The basics of scientific isolated. Hrushko IM, Sydenko VM-Kharkov: Higher School, 1983.-224s.
3. Fundamentals of scientific isolated: Textbook. For technical. University/ V.I. Krutov, IM Grushko, VV Popov et al.: - M.

Additional literature from theoretical course

1. Trifonova MF etc. - M.: Kolos, 1993.-186s.
2. Krynitsky SD The basics of scientific isolated. - K.: High School., 1981.-207s
3. Beshelev SD, Gurvich FG Mathematical-statistical methods of expert victorious .- M.: Statistics, 1980.-262s.
4. Periodic scientific and technical literature.

Information resources

1 NTB Ukrdazt (Kharkiv, Faeyurbach Square, 7).
2 Media Library of Ukrdazt (Kharkiv, Faievurbach Square, 7).
3 CDNB them. V.G. Korolenko (Kharkiv, Korolenko's lane 18).
4 Kharkiv CNTEI (Kharkiv, Gagarina Ave., 4).
5 Information resources on the Internet:

1. http://metod.kart.edu.ua/
2. http://do.kart.edu.ua/
3. http://kart.edu.ua/documentu-zvo-ua