Recommended
at the meeting of the Department of Automation and Computer Remote Control of Train Traffic

protocol № 9 dated 04.07.2022

SILABUS

from the discipline **«Automatics and traffic safety on high-speed railways»**

Semester and year of study:	***II 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 academic discipline

The purpose of teaching the academic discipline "Automatics and traffic safety on high-speed railways" (ATSHSR) is to provide theoretical and practical knowledge of construction features, basic technical requirements for infrastructure (track, rolling stock, power supply), features of control systems and ensuring the safety of train traffic on high-speed and high-speed highways (HSHW), modern information technologies in the components of railway automation systems (RAS), methods of organizing communication channels and information exchange between stationary and on-board RAS devices on HSHW, the impact of information provision of RAS systems on the safety of train traffic.

The main tasks of studying the discipline of ATSHSR are the development of theoretical knowledge and practical skills:

– features of construction, basic technical requirements for infrastructure (track, rolling stock, power supply), features of control systems and ensuring the safety of train traffic on HSHW, principles of their construction and functional capabilities in accordance with hardware, information, algorithmic, software, linguistic, etc. software;

– basic technical requirements for the functional safety of RAS systems to ensure the safety of train movement on the HSHW;

– features of control and signaling at races, organization of train and shunting work at stations, dispatcher control of train traffic;

– the social significance of HSHW and the technical and economic efficiency of train traffic management systems at HSHW.

The course aims to form and develop the following master's competencies:

1. *Scientific research, methodological*: the ability to abstract thinking, 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; the ability to solve problems in new and non-standard professional situations, taking into account the state and development of railway transport, social and ethical responsibility for the decisions made.

2. *Interpersonal interaction*: the ability to work in a team, conduct scientific discussions, convince and influence other participants in group processes, demonstrate a wide range of cognitive, legal and intellectual skills for the purposes of the effective functioning of train traffic control systems, including at HSHW, protection of intellectual property property; the ability to communicate and cooperate with specialists of other fields, to adapt in a social and professional environment.

3. *Social and personal*: the ability to realize the social significance of one's profession, to be aware of the responsibility for the results of one's professional activity before the public, to apply the principles of deontology in the performance of professional duties. To have an active civic position based on democratic beliefs, humanistic and ethical values.

4. *Instrumental skills*: mastering the skills of using modern software, Internet resources and working in computer networks, mastering the basic methods, methods and means of obtaining, storing and processing and using technical information in professional activities. Ability to oral and written business communication in national and foreign languages for communication in professional and socio-cultural spheres, information management skills, skills in working with modern technologies; the ability to apply

methods and means of technical measurements, technical regulations, standards and other regulatory documents.

5. *Ethical skills (motives)*: adaptability, sociability, creativity, tolerance, ability to system thinking and self-improvement, compliance with norms and principles of professional ethics, teaching skills; the ability to consciously replenish and expand communication skills in the professional sphere throughout life.

6. *Forecasting skills*: the ability to identify problems, set strategic goals, forecast the development of technological and economic processes, phenomena and railway infrastructure systems.

7. *Calculation skills*: the ability to use methods of planning, design, modeling, control, strategic analysis of technological and economic events, phenomena and mechanisms.

8. *Deep knowledge and understanding*: the ability to develop models, analyze and structure technological and economic events and phenomena from the point of view of knowledge of modern theoretical, organizational and methodological foundations of the construction and functioning of train traffic control systems; the ability to apply mathematical and statistical methods in the collection, systematization, generalization and processing of scientific and technical information, preparation of reviews, annotations, compilation of abstracts, reports and bibliography on research objects; to participate in scientific discussions and procedures for the defense of scientific works of various levels and presentations with reports and messages on the subject of conducted research; to possess ways of spreading and popularizing professional knowledge; reception

2. Why should you choose this course?

The smooth and safe movement of trains along the railway network is ensured by the RAS technical complex, which equips stations and races. The level of technical equipment (category) of the latter is determined by the class of railway stations. As an auxiliary or independent means of signaling, on-board traffic safety systems are used on mainline locomotives and motorcar trains, which, thanks to the appropriate information support for the conditions of safe driving of trains on railway lines of various classes, provide the locomotive crew directly in the locomotive cab with information about the state of the traffic route, its permits according to the train situation, the target and current traffic parameters, control the actions of the locomotive crew, reflect dangerous conditions in the process of train movement, implement the functions of train driving.

In the conditions of increasing the weight of freight trains, the introduction of accelerated, high-speed and high-speed traffic on railway lines, the dialectical process of the development of interval control systems and ensuring the safety of train traffic is obvious - the role of the optical channel of passing traffic lights is decreasing and the role of signal information transmission channels from stationary devices and from the track is increasing on the locomotive to increase traffic safety due to the operation of on-board devices of multi-valued ALS, determination of train movement parameters, its current coordinate, automatic brake control system, automatic train control, telemetric control of the driver's condition and forced stop of the train.

The discipline is based on the knowledge obtained during the study of fundamental, general-engineering and professionally-oriented disciplines, special disciplines of the profession at the first level of higher education.

In the lecture course, the study of the theoretical foundations of the HSHW infrastructure, features of train traffic control systems, technical means of RAS, reliability and safety of the HSHW is supplemented by practical classes, the purpose of which is to

familiarize with research methods and characteristics of typical methods and schematic solutions for the implementation of infrastructure components of the HSHW. The purpose of the practical classes is to acquire practical skills in substantiating the principles of building infrastructural components at HSHW (tracks, rolling stock, RAS systems for stations and races), analysis and development of effective information support for RAS systems at HSHW, modeling work and performing engineering calculations of main circuit nodes of RAS.

The team of teachers will be ready to provide any help with the most difficult aspects of the course by e-mail and in person - during working hours.

3. Description of the academic discipline

The academic discipline "Automation and traffic safety on high-speed railways", the study of which is allocated 120 hours/4.0 ECTS credits during the semester (1st year - 2nd semester), gives master's students a deep understanding of the application of basic scientific methods for ensuring the safety of train traffic through the improvement of infrastructural components HSHW, expansion of information support systems of stationary RAS systems and on-board signal autoregulation systems, use of modern information technologies in train traffic control - on-board computer equipment, digital duplex train radio communication, satellite navigation.

The course consists of 30 classroom hours of lectures, 15 hours of practical classes during one semester. It is accompanied by text lecture material, a distance learning course on the Moodle software platform, presentations.

Types of control – two modular test tasks and an exam. A web resource of the course has been developed, which is placed on the Moodle platform at the link do.edu.kart.ua. Master's students will have the opportunity to apply the acquired knowledge and solve practical tasks through discussions in the classroom during practical classes.

Interdisciplinary connections: the discipline of ATSHSR is based on the knowledge obtained during the study of fundamental, general engineering and professionally oriented disciplines of the educational program "Automation and computer-integrated technologies" of the first educational level (bachelor): higher mathematics, physics, theory of electrical and magnetic circuits, computer technology, electronics and microcircuit technology, theory of automatic control, general theory of systems, automatic systems in races, station automatic systems, special measurements and technical diagnostics, dispatch control systems.

The ATSHSR discipline is one of the basic ones for passing the state exam on the subject of construction of RAS systems at tracks and stations in the conditions of the organization of accelerated, high-speed and high-speed train traffic on railway lines.

The program of the academic discipline ATSHSR consists of the following content modules:

Content module 1.	Characteristics, features of construction, infrastructure requirements of high-speed and high-speed highways.
Content module 2.	Reliability and safety of HSHW. The influence of information provision of IRRP systems on the safety of train traffic. Peculiarities of arranging HSHW with railway automation devices.
Content module 3.	Control and signaling systems at races, organization of train and shunting work at stations, dispatch control at HSHW.
Content module 4.	Principles of construction of train traffic control systems on HSHW in Europe, Southeast Asia, the Russian Federation. Social significance and

technical and economic efficiency of HSHW.

Automation and traffic safety on high-speed railways / course outline

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Practical lessons of the course include:

– research and development of justifications for the construction of RAS systems for HSHW;

– analysis and construction of an information model of the driver's interface of a high-speed and high-speed train with the possibility of reflecting the mistakes of the locomotive crew with on-board autoregulation devices;

– research and analysis of the impact of information provision of IRRP systems on the safety of train traffic;

– determination of features of track construction, traction power supply, rolling stock, general requirements for high-speed rolling stock of HSHW;

– analysis of the technical specifications of the control and signaling systems on the HSHW, the features of the construction of executive devices of railway automation on the HSHW, their technical and economic efficiency.

The discipline is finalized with control measures (twice after the end of two educational modules - passing a test control for determining the quality of learning and an exam at the end of the semester). The work on the study of the course is accompanied by references to related disciplines, forms the master's student's innovative, informational and communicative competence.

4. Course resources

Information about the course is posted on the University's website http://do.kart.edu.ua/ (including necessary methodological materials, presentations, films, test tasks for individual content modules and course evaluation rules) in the "Distance Learning" section. The necessary preparation must be completed before the start of the lecture or practical session. During the discussion, it is proposed to carry out an analysis of the socio-economic feasibility of introducing high-speed train traffic on railways, requirements for the infrastructure of HSHW, construction features, the influence of information support on the effective functioning of RAS systems, ways to achieve reliability and functional safety of train traffic control systems through the use of infrastructure components of modern information technologies.

Examples of questions for discussion:

– justification for the construction and prospects for the introduction of high-speed train traffic on the railways of Ukraine;

– reliability and safety of HSHW;

– the essence of information provision of RAS systems for railway lines of different classes and its impact on the safety of train traffic;

– requirements for railway infrastructure in conditions of high-speed traffic (track, rolling stock, traction power supply);

– the principles of IRRP at the HSHW races and its technical implementation;

– peculiarities of the organization of train and shunting work at stations at stations with high-speed train movement;

– dispatching control of train traffic at HSHW;

– components of the technical and economic efficiency of train traffic control systems at HSHW.

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

5. Distribution of lectures into content modules

Content module 1. Characteristics, features of construction, infrastructure requirements of high-speed and high-speed highways.

Topic 1.1. Gradations of speed in railway transport. Classification of railway lines of Ukraine. HSHW, their characteristics, features of construction.

Topic 1.2. General problems of high-speed transport. Technical equipment of HSHW.

Topic 1.3. Peculiarities of train traffic control systems at HSHW.

Topic 1.4. Development of justifications for the construction of RAS systems for HSHW.

Topic 1.5. Conditions for driving a train by a locomotive crew at HSHW. Information model of the driver's interface of high-speed and high-speed trains.

Topic 1.6. Features of track construction, traction power supply, rolling stock on HSHW. General requirements for high-speed and high-speed rolling stock.

Content module 2. Reliability and safety of HSHW. The influence of information provision of IRRP systems on the safety of train traffic. Peculiarities of arranging HSHW with railway automation devices

Topic 2.1. The main technical requirements for the infrastructure and functional safety of RAS systems to ensure the movement of trains on HSHW. Methodology for proving the safety of RAS systems.

Topic 2.2. The influence of information support of IRRP systems on the safety of train traffic.

Topic 2.3. Peculiarities of arranging railway lines with RAS devices. Parameters and weighting factors affecting the safety of train movement at high speed.

Content module 3. Control and signaling systems at races, organization of train and shunting work at stations, dispatch control at HSHW

Topic 3.1. Technical specifications of control and signaling systems at HSHW.

Topic 3.2. Track equipment and hardware and software automation tools used at HSHW.

Topic 3.3. Control and signaling systems at HSHW races

Topic 3.4. Peculiarities of the organization of train and shunting work at stations with high-speed and high-speed train traffic.

Topic 3.5. Dispatch control at HSHW. Automated computer systems of dispatch control at HSHW. Dispatch control and diagnostics of automation devices at HSHW.

<u>Content module 4</u>. Principles of building train traffic control systems on HSHW in Europe, Southeast Asia, the Russian Federation. Social significance and technical and economic efficiency of HSHW

Topic 4.1. Implementation and development of high-speed traffic on foreign railways. Socio-economic significance of high-speed and high-speed railway transport.

Topic 4.2. The principles of building a train traffic control system on the HSHW in Europe, the Russian Federation, and Southeast Asia.

Topic 4.3. Technical and economic efficiency of train traffic control systems at HSHW.

6. Practical classes

№ i.o.	Topic name
PC 1	Gradations of speed in railway transport. Development of justifications for the construction of RAS systems for SZM.
PC 2	Information model of the driver's interface of high-speed and high-speed trains.
PC 3	Research and analysis of the impact of information provision of IRRP systems on the safety of train traffic.
PC 4	Development of effective information provision of train traffic management systems using transport process management models on sections of railways of various categories.
PC 5	Peculiarities of track construction, rolling stock on HSHW. Required for high-speed rolling stock.
PC 6	Types of rolling stock brakes. Calculations of the dependence of the braking distance of trains of different categories on the braking coefficient and track profile.
PC 7	Features of traction power supply at HSHW/
PC 8	Technical specifications of control and signaling systems at HSHW.
PC 9	Executive devices RAS on HSHW: overdraft, station, on-board,
PC 10	Principles of distribution of trains in the race on the HSHW and their technical implementation.
PC 11	Station systems of railway automation at HSHW: construction concept, structure and element base, functional capabilities.
PC 12	Automated computer systems of dispatch control at high-speed traffic areas. Dispatch control and diagnostics of automation devices at HSHW.

7. Independent work

№ i.o.	Topic name
1	Elaboration of lecture material based on educational literature and the distance learning course at the link http://do.kart.edu.ua (USURT distance learning tab - "Automatics and traffic safety on high-speed railways").
2	View films and presentations on the distance learning course at the link http://do.kart.edu.ua.
3	Preparation for practical classes.
5	Preparation and passing of tests of the first and second module control and content modules on the distance learning course at the link http://do.kart.edu.ua/.
6	Additional study of individual sections of the discipline, which are not taught in lectures.

8. Planned learning outcomes (OC)

The planned integral competence, general competences (GC), special (professional) competences (SC) are as follows.

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

2) General competences:

– GC2. Ability to generate new ideas (creativity);

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

– GC4. Ability to work in an international context.

3) Special (professional, subject) competencies:

– SC4. The ability to analyze production and technological systems and complexes as objects of automation, to determine methods and strategies for 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 when solving engineering problems and conducting scientific research;

– SC8. The ability to develop the functional, technical and information structure of computer-integrated management systems of organizational and technological complexes using network and information technologies, software and technical control complexes, industrial controllers, mechatronic components, robotic devices and human-machine interface tools.

4) Additional special competencies to the master's educational and scientific training program:

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

Planned learning outcomes (LO):

LO01	Conduct professional activities in social interaction based on humanistic and ethical principles.
LO02	Basic knowledge and practical skills of oral and written communication in a foreign language, analyzing specialized texts and translating foreign language information sources.
LO03	The ability to apply knowledge in the development and implementation of innovations, solving complex problems in professional activity, taking into account the relationship and interaction with other areas of activity.
LO04	The ability to demonstrate a wide range of cognitive and intellectual skills in the formation, improvement and implementation of information support of automation and computer control systems.
LO05	The ability to apply knowledge and understanding of the possibilities of developing and implementing a flexible strategy for the development of transport and industrial automation systems based on the effective use of accounting, technical and analytical information.

LO06	To develop the functional, organizational, technical and information structure of automation systems with complex technological and organizational and technical objects, to develop software and technical control complexes using network and information technologies, industrial controllers, mechatronic components, robotic devices, human-machine interface tools and taking into account technological conditions and requirements for production management.
LO07	The ability to demonstrate the ability of strategic analysis and predictive assessment of the technological processes of the functioning of automation systems and computer-integrated control and research of the effectiveness of the results of their improvement, development and design.

As a result of studying the academic discipline, the master's student must:

to know:

– requirements of standards, normative documents and industry instructions relating to RAS systems on railway lines of different classes;

– basic principles of construction, characteristics, requirements for infrastructural components of HSHW;

– basic technical requirements for the functional safety of RAS systems to ensure the safety of train movement on the HSHW;

– basics of using microprocessor equipment, modern digital train radio communication systems and satellite navigation systems in RAS systems;

– requirements for the information provision of RAS systems for railway lines of different classes and its impact on the safety of train traffic;

– technical specifications of control and signaling systems at the HSHW;

– principles of building hardware and software complexes and executive devices for HSHW.

be able:

– rationally and correctly choose effective methods of modeling, calculation, analysis and synthesis of the main subsystems and functional nodes of track and on-board components of the RAS;

– maintain the operational reliability and safety of functioning set for RAS devices;

– to ensure the necessary level of safety of train movement at the established capacity of railway stations;

– design typical systems and design separate new elements and nodes in accordance with operational and technical requirements for RAS systems for railway lines of various classes and categories, including with the use of computer and microprocessor technology;

have an idea:

– about the trends and prospects for the development of RAS systems and multi-level IRRP systems at railway lines and stations of various classes and categories for the near and distant future;

– construction structure and technological algorithms of functioning of domestic and foreign RAS systems with wide application of new information technologies and a modern elemental base;

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

– to be able to lead a discussion at scientific conferences and symposia and present one's own projects or qualification work as a whole structure;

– to acquire the ability to systemically creative thinking regarding the generation of possible ideas or approaches in the process of research and modeling of the methods and structure of hardware and software for ensuring the safety of train traffic.

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

Attending lectures

Points for this component are not awarded at all, if the master's student did not attend more than 50% of the lectures in the module without valid reasons. ***The maximum amount is 30 points***.

Practical training

They are evaluated by attendance and individual activity in classes. ***The maximum amount is 15 points.***

Degree of involvement

The purpose of participating in the course is to involve the master's student in the discussion, to expand the learning opportunities for himself and his partners, to give him another way to test his theoretical and practical knowledge of scientific research methods, to achieve the efficiency of use and safe operation of traffic safety systems on railway lines of various classes and categories, requirements for infrastructural components of railway lines, the basic principles of their construction, methods of organizing communication channels and exchanging information between stationary and on-board RAS devices, the impact of RAS information support systems on the safety of train traffic, the achievement of electromagnetic compatibility requirements by RAS devices.. Participation will be be evaluated based on the number and accuracy of your answers. Questions, although encouraged, are not graded in this unit. We strive to provide all students with equal and fair opportunities to increase their own engagement. ***The maximum amount is 15 points.***

Final module test. ***The maximum amount is 40 points***.

Exam. The student receives an examination grade based on current control by accumulating points. The maximum number of points that a student can get is 100 (up to 60 points of the current control and up to 40 points during the final module test). If the student does not agree with the proposed points, he can increase them on the exam by answering the questions on the exam ticket (http://do.kart.edu.ua/course/view.php?id=1454).

10 Means of diagnostics of learning success

1. Oral current survey at lectures, practical classes.
2. The system of monitoring the level of knowledge by the method of testing on a personal computer while working on a course in the distance form of education.
3. Knowledge level control system by PC testing during modular control.
4. A written answer to the questions of the examination ticket on theoretical questions and tasks on the exam (if necessary at the initiative of the master's student).

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 the following link: http://kart.edu.ua/documentu-zvo-ua.

In particular, compliance with the Code of Academic Integrity of USURT means that all work on exams and tests must be done individually. During independent work, students can consult with teachers and other students, but must solve tasks independently, guided by their own knowledge, abilities and skills. References to all resources and sources (for example, in reports, independent papers or presentations) should be clearly identified and properly formatted. In the case of joint work with other students on individual tasks, you should indicate the degree of their involvement in the work.

12. Integration of students with disabilities

Higher education is a leading factor in raising social status, achieving spiritual and material independence and socialization of youth with limited functional capabilities and reflects the state of development of democratic processes and humanization of society.

To integrate students with disabilities into the educational process of the USURT, a distance learning system was created based on modern pedagogical, information, and telecommunication technologies. Access to distance learning materials from this course can be found at the link: http://do.kart.edu.ua/ (the name of the course on the USURT insert is "Automation and traffic safety on high-speed railways").

Recommended Books

The main one

1. Boynyk A.B., Koshevoy S.V., Panchenko S.V., Sotnyk V.A. Systems of interval regulation of the movement of trains on races: Teaching manual. Kharkiv: UkrGAZHT 2005. – 256 p.
2. Lysenkov V.M. Statistical theory of train movement safety. - M.: VYNITY RAS, 1999.-332p.
3. Lysenkov V.M. Theory of automatic interval regulation systems. - M.: Transport, 1987.-150 p.
4. Internet resource. Training course with elements of distance learning "Automation and traffic safety on high-speed railways" based on the MOODLE web environment of the UkrDUZT website at the link do.kart.edu.ua.

5. Directive 91/440/EEC (Council Directive of 29 July 1991 on the development of the Community's railways (91/440/EEC)).
6. Directive 96/48/EC. On operational compatibility of trans-European high-speed systems.
7. Directive 2001/16/EC. On operational compatibility of ordinary railway lines.
8. Directive 2008/57/EC "On the interoperability of the Community rail system".
9. CENELEC: Railway applications — Specification and demonstration of reliability, availability, maintainability and safety [RAMS], EN 50126:1999.
10. CENELEC: Railway applications—Communications, signaling and processing systems—Software for railway control and protection systems. EN 50128:2001.
11. CENELEC: Railway applications—Communications, signaling and processing systems—Safety related electronic systems for signaling. EN 50129:2003.
12. Unisig: ERTMS/ETCS — Class 1 Subset-026: System Requirement Specifications. Version 2.3.0, 2006.
13. Unisig: ERTMS/ETCS — Class 1 Subset-026: System Requirement Specifications. Draft version 3.0.0, December 2008.
14. Automation and Telemechanics Systems on the World's Railways Edited by Gregor Teeg, Sergey Vlasenko. Publisher: Intex, 2012. 487 p.
15. Methods of building harmless microelectronic systems of railway automation / V.V. Sapozhnikov, Vl. V. Sapozhnikov, X. A. Hristov, D. V. Havzov; Ed. Vl. V. Sapozhnikova. M.: Transport, 1995. 272 p.
16. Concentration and centralization of operational control of train movement / V. V. Sapozhnikov, D. V. Gavzov, A. B. Nikityn. M.: Transport, 2002. 102 p.
17. Industry standard OST 32.17 — 92. Safety of railway automation and telemechanics. Basic concepts. Terms and definitions. Automation and telemechanics of the VSM.
18. Astrakhan V.I. Unified locomotive safety device (CLUB-U): Study guide: [Text] / V.I. Astrakhan, V.I. Zorin, G.K. Kiselhof and others Ed. YOU. Zoryna and V.I. Astrakhan. - M.: GOU "Educational and Methodological Center for Railway Transport Education". 2008. – 177 p.

Additional

1. Rules for the technical operation of railways of Ukraine, approved by the order of MTU dated 20.12.1996 No. 411, with changes and additions introduced by orders of MTU No. 226 dated 8.06.1998, 23.07.1999 No. 386, dated March 19, 2002 No. 179.
2. Instruction on signaling on railways of Ukraine. TSH 0001, Kyiv: Ministry of Transport of Ukraine, 2008.
3. Instruction on the movement of trains and shunting work on the railways of Ukraine. - CD 0001, Kyiv: Ministry of Transport of Ukraine, 1995.
4. Railways of the world. 2004-2020
5. Railway transport. 2004-2020
6. Periodic scientific and technical literature.

Information resources

1 NTB UkrDUZT (Kharkiv, Feuerbacha Square, 7).
3 KhDNB named after V.G. Korolenko (Kharkiv, Korolenko Ave. 18).
4 Kharkiv Central Technical University (Kharkiv, 4 Gagarina Ave.).
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