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APPROVING
Director of the Institute of
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CATALOG OF DISCIPLINES OF THE COMPONENT BY CHOICE

EDUCATIONAL PROGRAM

6B07184 ENGINEERING OF CONSTRUCTION AND RAILWAY TECHNOLOGY

Education level: bachelor's degree

Training period: 3 years

Year of admission: 2025

Cycle	Component	Name of the discipline	General labor intensity		Semester	Learning Outcomes	Brief description of the discipline	Prerequisites	Postrequisites
			in academic hours in academic credits	in academic hours in academic credits					
1	2	3	4	5	6	7	8	9	10
GED	EC1	Environmentally sustainable technologies	150	5	6	LO4	The discipline "Environmentally sustainable technologies" studies modern methods and innovative solutions aimed at minimizing the negative impact of human activities on the environment. The course examines the principles of sustainable development, energy-saving technologies, renewable energy sources, waste management strategies, and environmentally sound production processes.	Basic school environmental knowledge	Occupational health and safety
	EC2	Green economy and sustainable entrepreneurship				LO6	The discipline "Green Economy and Sustainable Entrepreneurship" is devoted to the study of environmentally oriented economic models and business strategies aimed at sustainable development. The course examines the concepts of the green economy, ESG (Environmental, Social, Governance) approaches, circular economy, sustainable business models and their impact on global mar-	The socio-political knowledge module	Managerial Economics, Time -management

							kets.		
	EC3	Fundamentals of financial literacy				LO5	The discipline is aimed at developing the ability to make informed financial decisions, plan income and expenditures, assess risks and effectively manage their resources in a market economy. It studies the basic knowledge in the sphere of finance and rational management of monetary resources, the concepts of financial system, budget, banking products, crediting, savings, investments, insurance, taxation and protection against financial fraud are considered.	The socio-political knowledge module	Managerial Economics, Time -management
	EC4	Digital inclusion				LO1	The discipline "Digital Inclusion" is devoted to the study of the principles of ensuring equal access to digital technologies and information for all social groups, including people with disabilities. The course examines barriers to digital inequality, strategies for overcoming them, technologies for adapting the digital environment, and government initiatives to develop an inclusive digital society.	The socio-political knowledge module	Managerial Economics, Time -management
	EC5	Basics of law and anti-corruption culture				LO1	The discipline outlines the fundamental concepts of law, the constitutional structure of the state power of the Republic of Kazakhstan, the rights and freedoms of citizens enshrined in the Constitution, the mechanism and protection of legitimate human interests in case of their violation. The discipline forms students' improvement of public and individual legal awareness and legal culture, as well as a system of knowledge and citizenship on combating corruption as an antisocial phenomenon.	The socio-political knowledge module	Managerial Economics, Time -management
BD	EC6	Hydraulics and hydraulic drive	120	4	3	LO7	The discipline studies the general laws and equations of fluid dynamics, modes of fluid motion and the basics of hydrodynamic similarity, laminar and turbulent fluid motion, hydraulic resistance, fluid flow through holes and nozzles. As well as hydraulic calculation of pipelines, volumetric hydraulic machines, hydraulic drives and hydraulic automation, pneumatic drive, pneumatic motor, pumps, hydraulic motors, fans, hydrodynamic gears, hydraulic drives of metal cutting tools. The teaching methods are: problem solving, conducting thematic surveys, open and closed	Engineering Mathematics 1; Engineering Mathematics 2; Structural materials in transport engineering	Machine parts and design basics; Reliability of construction and railway machinery; Continuous transport machinery and equipment

							tests.		
	EC7	Tribotechnics				LO7	The discipline studies the basic concepts of contact and friction of touching surfaces, the basic definitions and formulation of the problem, the analysis of contact and the area of contact. As well as sliding friction, rolling, hydrodynamic friction, the main characteristics and types of wear, methods for ensuring high operational properties of friction units and the specifics of the design of friction units, the basics of calculations in the design of sliding bearings, rolling bearings, evaluation of the durability of friction units. The discipline uses interactive teaching methods.	Engineering Mathematics 1; Engineering Mathematics 2; Structural materials in transport engineering	Machine parts and design basics; Reliability of construction and railway machinery; Continuous transport machinery and equipment
BD	EC8	Fundamentals of calculating the strength of machines and mechanisms	150	5	3	LO6	Studies the basics of the theory of mechanisms and machines, the resistance of materials, calculation and design of general-purpose parts and assemblies widely used in machines to solve problems aimed at improving the reliability, strength and durability of parts and assemblies in design, construction and operation, using modern educational and information technologies. Methods of active learning – performing individual computational and graphical tasks.	Engineering Mathematics 2; Applied Physics; Theoretical mechanics	Machine parts and design basics; Machine design automation systems; Lifting and transport machines
	EC9	Applied Mechanics				LO6	Studies the theoretical foundations and methods of calculations for strength, rigidity, durability and stability of structural elements of transport structures, the main types of mechanisms, parts and assemblies of machines, general principles of design and construction, which is necessary when assessing the reliability of existing equipment in operating conditions. Methods of active learning – performing individual computational and graphical tasks.	Engineering Mathematics 2; Applied Physics; Theoretical mechanics	Machine parts and design basics; Machine design automation systems; Lifting and transport machines
BD	EC10	Fundamentals of automation of design of construction and track machines	180	6	6	LO9	Studies methods of automation of design of construction and track machines using modern software tools. Special attention is paid to computer-aided design (CAD) systems, 3D modeling, digital technologies, analysis and optimization of structures. Practical skills are being developed in	Metrology, standardization and certification; Energy installations of transport equipment; Fundamentals of the rail-	Complex mechanization of loading and unloading operations; Machines for earthworks; Drives and control systems for construction and track ma-

							the development, evaluation and improvement of equipment for the construction and transport industries.	way track	chines; Design of metal structures for construction and track machines
	EC11	Automated design systems for machines				LO9	The discipline explores key principles and tools for automating machine design using modern CAD systems. It covers methods of 3D modeling, parameterization, structural analysis, and creation of design documentation. Special attention is given to the use of digital twins and artificial intelligence algorithms to optimize design decisions and enhance engineering efficiency in a virtual environment.	Metrology, standardization and certification; Energy installations of transport equipment; Fundamentals of the railway track	Complex mechanization of loading and unloading operations; Machines for earthworks; Drives and control systems for construction and track machines; Design of metal structures for construction and track machines
BD	EC12	Reliability of construction and railway machinery	180	6	4	LO6	Explores principles of ensuring the reliable and long-term operation of construction and road machinery, analyzing causes of failures and methods for their prevention. Covers theoretical foundations of reliability, failure types and parameters, technical diagnostics, preventive maintenance, repair planning, and service life prediction. Emphasis is placed on operational conditions, technical and economic indicators, and improving machine efficiency. Students develop practical skills to ensure uninterrupted and safe machinery performance in real-world working environments.	Tribotechnics; Applied Mechanics; Electrical engineering and the basics of electronics	Metrology, standardization and certification; Energy installations of transport equipment
	EC13	Machine design automation systems				LO6	Focuses on fundamental principles and mathematical methods for analyzing the reliability of technical systems and components. Topics include failure-free performance, durability, maintainability, and storability. Emphasis is placed on probabilistic failure models, reliability functions, calculation of reliability indicators, and development of reliability assurance schemes. Students gain skills in assessing technical resources and justifying decisions during design, operation, and modernization of equipment.	Tribotechnics; Applied Mechanics; Electrical engineering and the basics of electronics	Metrology, standardization and certification; Energy installations of transport equipment
BD	EC14	Basics of technical operation of transport equipment	120	4	8	LO6	The principles of ensuring the operability of transport equipment, maintenance and repair systems, as well as patterns of changes in its technical condition are considered. Competencies are being formed in the field of operational management, technical resource assessment and informed	Complex mechanization of loading and unloading operations; Machines for earthworks; Drives and control systems for	Travel machines and mechanisms; Integrated mechanization, automation and mechanization of road construction; Technical diagnostics of con-

							decision-making in specific production environments. Regulatory approaches, the structure of engineering services, and elements of sustainable operation, taking into account resource conservation, are being studied.	construction and track machines	struction and track machines; Industrial practice 2 / pre-graduate practice
	EC15	Technical operation of construction and track vehicles				LO8, LO9, LO10	Focuses on the organization of technical operation of construction and road machinery, including maintenance, current and major repairs, diagnostics, and service life extension. Covers operating modes, working conditions, lubricants, control systems, and technical condition monitoring. Evaluates the impact of operational factors on reliability, performance, and economic efficiency. Develops practical skills for making informed decisions on machinery operation in various climatic and technological conditions.	Complex mechanization of loading and unloading operations; Machines for earthworks; Drives and control systems for construction and track machines	Travel machines and mechanisms; Integrated mechanization, automation and mechanization of road construction; Technical diagnostics of construction and track machines; Industrial practice 2 / pre-graduate practice
BD	EC16	Intelligent and digital technologies in track machines	180	6	8	LO3, LO9	The discipline focuses on the study of modern digital solutions and artificial intelligence technologies used in track machines. It covers intelligent control systems, automation of operational processes, predictive diagnostics, and condition monitoring using sensor systems and AI algorithms. Special attention is given to the implementation of digital twins, machine vision, and the integration of track machines into the overall digital railway infrastructure system.	Mechanization of transshipment operations; Special machines for earthworks; Internal combustion engines	Specialized railway equipment; Integrated systems of mechanization and automation of road construction; Industrial practice 2 / pre-graduate practice
	EC17	Digital technologies in construction				LO3, LO9	The discipline studies digital technologies applied in the design, analysis, and operation of road construction machinery and equipment. It covers digital modeling methods for earthmoving, material processing, concrete mixing, and pavement laying processes. The interaction between working components and materials is analyzed through simulations and digital twins, while machine parameters are selected using AI and data analysis. Topics include predictive diagnostics, automated control, and the use of intelligent systems for optimizing maintenance. Examples of BIM and CAD/CAM technologies in road construction are also presented.	Mechanization of transshipment operations; Special machines for earthworks; Internal combustion engines	Specialized railway equipment; Integrated systems of mechanization and automation of road construction; Industrial practice 2 / pre-graduate practice
PD	EC18	Lifting and transport ma-	180	6	4	LO8	The discipline examines the following issues: general information; assembly units, parts of lift-	Hydraulics and hydraulic drive; Fun-	Metrology, standardization and certification; Energy

		chines					ing and transport machines; lifting and transporting machines. The general devices and operating processes of lifting and transport machines, methods of basic parameters and determination of their structural and operational characteristics, the basics of the methodology for selecting braking and stopping devices, and the methodology for selecting engines, gearboxes, and lifting devices from among the normalized or standard ones are studied.	damentals of calculating the strength of machines and mechanisms; Electrical engineering and the basics of electronics; Educational practice	installations of transport equipment; Fundamentals of the railway track
	EC19	Continuous transport machinery and equipment				LO8	Explores principles of ensuring the reliable and long-term operation of construction and road machinery, analyzing causes of failures and methods for their prevention. Covers theoretical foundations of reliability, failure types and parameters, technical diagnostics, preventive maintenance, repair planning, and service life prediction. Emphasis is placed on operational conditions, technical and economic indicators, and improving machine efficiency. Students develop practical skills to ensure uninterrupted and safe machinery performance in real-world working environments.	Hydraulics and hydraulic drive; Fundamentals of calculating the strength of machines and mechanisms; Electrical engineering and the basics of electronics; Educational practice	Metrology, standardization and certification; Energy installations of transport equipment; Fundamentals of the railway track
PD	EC20	Managerial Economics	90	3	6	LO5	Formation of the conceptual apparatus and development of skills of economic analysis using modern models and patterns of economic science, consideration of economic problems and challenges facing the head of the firm. The study of this discipline will allow students to obtain and develop knowledge in the field of analytical research of economic, technological and technical parameters of the enterprise, as well as allow you to master the skills of using special methods of economic justification of management decisions and assessment of their consequences.	Green economy and sustainable entrepreneurship; Fundamentals of financial literacy; Basics of law and anti-corruption culture	Final certification
	EC21	Time - management				LO5	The discipline studies a system of methods, tools and approaches that are aimed at effective time management in order to achieve set goals. The course is designed to improve skills in organizing and optimizing the use of working time, increasing productivity, reducing stress, planning, delegation, using tools and technologies, as well as knowing your time and energy rhythms in order to use your time effectively.	Green economy and sustainable entrepreneurship; Fundamentals of financial literacy; Basics of law and anti-corruption culture	Final certification

PD	EC22	Infrastructure of construction and track vehicles	120	4	1	LO5	The discipline explores the infrastructure of railway transport in the Republic of Kazakhstan, including track and construction machinery, railways, and network operation. It covers the principles of operation, management structure, railway transport industries, and tasks of interaction within the national transport system. Special attention is given to information technologies and AI for optimizing operations, diagnostics, and planning, including fault prediction, automated train control, and track monitoring.	The socio-political knowledge module	Information and communication technologies; Applied Physics; Theoretical mechanics
	EC23	Technical base of construction and track vehicles				LO5	The discipline examines the following issues: general information about railway transport, construction and track vehicles, types of railway transport, their features and importance in the country's economy, transport products, its meters, the main directions of transport policy, features and technical and economic characteristics of the use of construction and track vehicles, the role of railways in the unified transport system of the country, the main indicators of its work, the work of railway transport in modern economic conditions.	The socio-political knowledge module	Information and communication technologies; Applied Physics; Theoretical mechanics
PD	EC24	Travel machines and mechanisms	180	6	9	LO8	The design, theory and calculation of track machines and mechanisms used in the construction, repair and maintenance of railways are studied. The working processes, methods of ballasting, straightening of the track, cleaning of crushed stone and snow, as well as control and measuring equipment are considered. Methods of calculation and selection of parameters of working bodies of machines are given.	Occupational health and safety; Intelligent and digital technologies in track machines; Construction machines	Industrial practice 2 / pre-graduate practice; Final certification
	EC25	Specialized railway equipment				LO8	The types, structure and principles of operation of specialized railway equipment used for laying, repairing and maintaining tracks, contact network and infrastructure are considered. Technical parameters, operating conditions and application technologies are being studied. Skills of analysis, selection and effective use of machines in various production conditions of railway transport are being developed.	Occupational health and safety; Intelligent and digital technologies in track machines; Construction machines	Industrial practice 2 / pre-graduate practice; Final certification
PD	EC26	The technical	180	6	3	LO6	He studies the basic principles and methods of	Theoretical	Machine parts and design

		basics of creating machines					designing construction and track machines, design documentation, standardization in mechanical engineering, issues of invention and rationalization in the designer's work, analysis of patent information and scientific and technical literature, technical and economic indicators of machines at the design stage, the choice of optimal solutions to improve the quality of machines.	mechanics; Applied Physics	basics; Reliability of construction and railway machinery; Lifting and transport machines
	EC27	Machine design and construction				LO6	Covers principles, methods, and stages of designing machines and their components with a focus on strength, reliability, manufacturability, and safety. Includes analysis of static and dynamic loads, material selection, standardization of components, and application of modern CAD systems. Emphasis is placed on developing practical skills in engineering design, technical documentation, and using analytical approaches for solving complex mechanical engineering problems. Encourages systems thinking essential for effective machine development.	Theoretical mechanics; Applied Physics	Machine parts and design basics; Reliability of construction and railway machinery; Lifting and transport machines
PD	EC28	Complex mechanization of loading and unloading operations	180	6	7	LO10	Covers systems and processes of comprehensive mechanization of loading and unloading operations using specialized machines and equipment. Examines types of handling mechanisms, technological schemes, process automation, and equipment selection based on cargo type and operating conditions. Evaluates the impact of mechanization on productivity, labor intensity, and occupational safety. Develops skills in designing mechanized work areas, selecting efficient technical solutions, and assessing the effectiveness of applied systems.	Production technology and repair of construction and track machinery; Automated design systems for machines; Industrial practice 1	Construction machines; Means of mechanization of road facilities; Resource saving in transport
	EC29	Mechanization of transshipment operations				LO10	The discipline studies the structure, technological operations and main indicators of the transshipment process, technical means of mechanization of transshipment operations, their characteristics and scope of application, performance of transshipment machines, lifting devices for cyclic machines, universal schemes of transshipment, classifications, warehouses, and the transshipment process is also studied as an integral part of the transport process.	Production technology and repair of construction and track machinery; Automated design systems for machines; Industrial practice 1	Construction machines; Means of mechanization of road facilities; Resource saving in transport

PD	EC30	Machines for earthworks	180	6	7	LO8	The discipline studies the following issues: general information; earthmoving machines; earthmoving and transport machines; machines and equipment for soil compaction, preparatory, auxiliary and special earthworks; fundamentals of the design and operation of machines for earthworks, current development trends, work features and methods of calculating operating parameters, improving methods of using the fleet of earthmoving machines and increase their productivity.	Production technology and repair of construction and track machinery; Fundamentals of automation of design of construction and track machines; Industrial practice 1	Construction machines; Means of mechanization of road facilities; Resource saving in transport
	EC31	Special machines for earthworks				LO8	The discipline examines the following issues: general information, machines for preparatory and earthmoving operations, drilling and crane machines, machines for compacting soil and other materials, ramming machines, small-sized drilling machines from Merlot, a small-scale roller on a Merlot loader, vibrating plates.	Production technology and repair of construction and track machinery; Fundamentals of automation of design of construction and track machines; Industrial practice 1	Construction machines; Means of mechanization of road facilities; Resource saving in transport
PD	EC32	Construction machines	180	6	8	LO8	The classification of construction machinery, principles of complex mechanization, calculation of productivity, purpose and device of various types of machinery are studied. The high-altitude and traction-speed characteristics, parameters of lifting and transport, earthen, pile, transport and soil compaction machines are considered. The theoretical foundations, examples of calculations and principles of optimal machine acquisition are given.	Complex mechanization of loading and unloading operations; Machines for earthworks; Internal combustion engines	Travel machines and mechanisms; Integrated mechanization, automation and mechanization of road construction; Industrial practice 2 / pre-graduate practice
	EC33	Means of mechanization of road facilities				LO10	The discipline examines the following issues: basic information about the purpose, scope, device, work processes and technological capabilities of the means of mechanization used in the road industry, general information about the types of machines and mechanisms of domestic and foreign production that are most common in the construction, maintenance and repair of city streets and highways, the main technical characteristics for calculating their performance.	Complex mechanization of loading and unloading operations; Machines for earthworks; Internal combustion engines	Travel machines and mechanisms; Integrated mechanization, automation and mechanization of road construction; Industrial practice 2 / pre-graduate practice
PD	EC34	Drives and control systems for construction and	180	6	7	LO7	Covers the design, operation principles, and application features of mechanical, hydraulic, pneumatic, and electric drives used in construc-	Energy installations of transport equipment; Production	Construction machines; Resource saving in transport; Intelligent and

		track machines					tion and road machinery. Examines control systems including automated and electronic modules, sensors, and actuators. Focuses on drive characteristics, control schemes, reliability, and operational efficiency. Develops practical skills in selecting and designing drive and control systems considering working conditions, safety, and energy efficiency.	technology and repair of construction and track machinery	digital technologies in track machines; Technical operation of construction and track vehicles
	EC35	Internal combustion engines				LO7	The discipline studies the following issues: engine performance and operating conditions; engine characteristics; calculation of the actual engine cycle; basic principles of operation of an internal combustion engine, processes of intake and exhaust of the working mixture, exhaust gases, indicators of efficiency, efficiency and perfection of the engine design, parameters and indicators of gas exchange processes, heat exchange and thermal balance during compression.	Energy installations of transport equipment; Production technology and repair of construction and track machinery	Construction machines; Resource saving in transport; Intelligent and digital technologies in track machines; Technical operation of construction and track vehicles
PD	EC36	Integrated mechanization, automation and mechanization of road construction	180	6	9	LO10	The methods of complex mechanization and automation of road construction processes are being studied, including the use of specialized equipment for laying, excavation and planning. Technologies for improving the mechanical equipment of construction are considered, as well as the introduction of automated systems to improve the efficiency, quality and safety of road works at all stages of construction.	Digital technologies in construction; Basics of technical operation of transport equipment; Means of mechanization of road facilities	Final certification
	EC37	Integrated systems of mechanization and automation of road construction				LO10	Complex systems of mechanization and automation of road construction are being studied, including the use of specialized machines and automated processes to perform various stages of work. Technologies for integrating equipment, management, and monitoring aimed at improving productivity, accuracy, and quality of road construction, as well as reducing costs and time, are considered.	Digital technologies in construction; Basics of technical operation of transport equipment; Means of mechanization of road facilities	Final certification
PD	EC38	Design of metal structures for construction and track machines	90	3	7	LO6	Focuses on the design principles of metal structures used in construction and road machinery, considering operational conditions, loads, and requirements for strength, stability, and rigidity. Covers calculation methods for welded, bolted, and riveted joints, material selection, and the de-	Fundamentals of automation of design of construction and track machines; Production technology and repair of con-	Basics of technical operation of transport equipment; Intelligent and digital technologies in track machines; Construction machines

							sign of frames, booms, platforms, and other load-bearing components. Emphasis is placed on optimizing structural weight while maintaining performance. Develops practical skills in preparing technical documentation and using modern design software tools.	struction and track machinery; Production practice 1	
	EC39	Minor program 1				LO3	The first of the three disciplines, which allows you to form additional professional competencies in various subject areas.	Fundamentals of automation of design of construction and track machines; Production technology and repair of construction and track machinery; Production practice 1	Basics of technical operation of transport equipment; Intelligent and digital technologies in track machines; Construction machines
PD	EC40	Resource saving in transport	90	3	8	LO4	The study of the main types and characteristics of energy resources, regulatory and legal support for energy conservation, improving the energy efficiency of the transportation process; energy-saving technologies in repair production and operation of transport infrastructure facilities; organization and methods of energy conservation management. They are used to solve problems, conduct thematic colloquiums, debates. Guest lectures are being held by leading experts of the transport and communication industry.	Infrastructure of construction and track vehicles; Technical base of construction and track vehicles; Green economy and sustainable entrepreneurship	Industrial practice 2 / pre-graduate practice; Final certification
	EC41	Minor program 2				5	The second of the three disciplines, which allows you to form additional professional competencies in various subject areas.	Infrastructure of construction and track vehicles; Technical base of construction and track vehicles; Green economy and sustainable entrepreneurship	Industrial practice 2 / pre-graduate practice; Final certification
PD	EC42	Technical diagnostics of construction and track machines	90	3	9	LO8	Focuses on methods and tools for technical diagnostics of construction and road machinery to assess condition, prevent failures, and optimize maintenance. Includes principles of non-destructive testing, vibration analysis, thermography, and modern monitoring systems. Diagnostic data are evaluated to support decisions on repair strategies and service life. Develops skills in	Means of mechanization of road facilities; Resource saving in transport	Final certification

							technical condition assessment, interpretation of diagnostic results, and selection of appropriate diagnostic methods based on operational conditions.		
	EC43	Minor program 3				LO9	The third of the three disciplines, which allows you to form additional professional competencies in various subject areas.	Means of mechanization of road facilities; Resource saving in transport	Final certification
Total:			3000	100					