WP2.1. Survey of courses (Jizzakh PolytechnicInstitute)

Master Program "Intelligent Transport Systems"
Graduate qualification (degree) - Master
Normative period of full-time program development - 2 years

1. Characteristics of professional activity of a graduate

The field of professional activity of a graduate

1. Analysis and design of intelligent transport systems
2. Automated information processing and motion control systems
3. Information support for traffic participants
4. Automated systems software

Objects of the graduate's professional activity

1. Computers, complexes, systems and networks;
2. Automated information processing systems for transport
3. Telematics and intelligent transport systems
4. Mathematical, informational, technical, linguistic, software,

Ergonomic, organizational and legal support for the systems listed above.

Types of professional activity of a graduate

1. Design and development activities;
2. Design and technological activities;
3. Research activities;
4. Scientific and pedagogical activity;
5. Organizational and management activities.

2. Graduate competencies formed as a result of the development of new msc program

The main educational programs of the Master's degree program include the following study cycles:

1. General science cycle;
2. Professional cycle and sections:
3. Practice and research;
4. Final state certification.

Each training cycle has a basic (mandatory) part and a variable (profile) one established by the university. The variable part provides an opportunity to expand and/or deepen the knowledge, skills, abilities and competencies defined by the content of the basic disciplines (modules), allowing the student to acquire in-depth knowledge, skills and competencies for successful professional activities and (or) postgraduate studies.

The Syllabus in ITS provides for the formation of the following general cultural competencies:

- is able to improve and develop its intellectual and cultural level;
- is able to independently study new research methods and change the scientific and production profile of its professional activity;
- is able to use UZBEK and foreign languages freely as a means of business communication;
- uses in practice skills and abilities in organization of research and design works, in team management;
- is able to take the initiative, including in risk situations, to assume full responsibility;

- is able to independently acquire with the help of information technologies and use new knowledge and skills in practice, including in new areas of knowledge not directly related to the field of activity;
- is capable of professional operation of modern equipment and devices (in accordance with the objectives of the master's program);
- to apply perspective methods of research and solution of professional tasks on the basis of knowledge of world tendencies of development of computer engineering and information technologies;
- on the basis of the knowledge of pedagogical methods to take a direct part in the educational work of the departments and other educational units in the profile of the direction of "ITS";
- develop and implement plans for informatization of enterprises and their subdivisions on the basis of Web- and CALS-technologies;
- to form technical specifications and participate in the development of hardware and / or software computing equipment);
- select methods and develop algorithms for solving control tasks and designing automation objects;
- to apply modern technologies of software development with the use of CASE-means, to control the quality of developed software products (PC-6);
- to organize and manage the work of hardware and/or software developers of information and automation systems.

3. Example of curriculum

Master's Degree in "Intelligent Transport Systems"
Qualification - Master
Normative period of training - 2 years

First option

N	Name of disciplines (including practices)	Credits	Hours	Approximate distribution by semester				Form of intermediate certification.
		Labor intensity according to FGOS	Labor intensity	1st semester	2nd semester	3rd semester	4th semester	
				Number of weeks				
1	2	3	4	5	6	7	8	9
M1	**General science cycle**	**18**	**648**					
M1. B.	*Basic part*	*6*	*216*					
1	Intelligent transport systems	*6*	*216*	X				examination
M1. V.	*Variable part, Mandatory disciplines*	*12*	*432*					
1	Modeling and optimization of transport flows	*6*	*216*	X				Examination
M1. DV.	*Student selection disciplines*	*6*	*216*					

1.1	Extended English	*6*	*216*	X				grade point
1.2	Foreign language in business communication	*6*	*216*	X				grade point
M.2	**Professional cycle**	**44**	**1584**					
M2. B.	*Basic part*	*14*	*504*					
1	Positioning technologies in railway transport ITS	4	144	X				examination
2	Study of operations in the tasks of ITS	6	216	X				examination
3	Data analysis, modelling and management techniques in ITS	4	144		X			examination
M2. V.	*Variable part, Mandatory disciplines*	*30*	*1080*					
1	Computer networks and information security	7	252	X	X			the test, the exam.
2	Traffic Safety Management on Railway Transport	6	216			X		examination
3	Logistics multimodal systems and ITS	5	180		X			Examination
4	Image recognition methods and data mining in ITS tasks	4	144		*X*			Examination
M2. DV.	*Student selection disciplines*	*8*	*288*					
1.1	Wireless mobile communications	5	180			X		Examination
1.2	Telecommunications in IHS	5	180			X		Examination
2.1	Data analysis, modelling and management techniques in ITS (Advanced Course)	3	108			X		Examination
2.2	Algorithms, data structures, soft computing	3	108			X		Examination
M. 3	**Practice, R&D**	**46**	**1656**					

M3. N.	*Research work*	*24*	*864*					
1	Infrastructure, telematics and information technologies of railway transport ITS	*6*	*216*		X			
2	Applied modelling and optimization of management processes in ITS	6	216			X		
3	Ergatic railway transport systems (in ITS conditions)	6	216				X	
4	Geoinformation systems for transport	6	216		X			
M3. P.	*Industrial practice*	*4*	*144*					
1	Scientific and pedagogical practice	4	144			X		
M.4	**Final state certification**	**18**	**648**				**X**	

Second option

№	**Name of subjects**	**Study load of student (hours)**								**Hours distribution by semesters and weeks**			
		Total load		**Auditorium exercises (hours)**					**Independent work**	**1 year**		**2 year**	
										1	**2**	**1**	**2**
		hours	**%**	**Total**	**lecture**	**practice**	**laboratory**	**course work**		**Number of weeks in semestr**			
										20	**20**	**20**	**18**
1	**General methodological subjects**	**451**	**30**	**308**	**88**	**204**	**16**		**145**	**9**	**4**	**1**	
1.01	Social and economic development strategy in Uzbekistan	58		40	20	20			19	2			
1.02	Theory and Methodology of Science	94		64	16	32	16		30	3			
1.03	Pedagogical technologies and pedagogical skills	58		40	20	20			19		2		
1.04	English	147		100		100			47	2	2	1	

1.05	ITS basics	94		64	32	32			30	2			
2	**Specialization subjects**	**1100**	**55**	**992**	**384**	**336**	**272**	**CW CP**	**248**	**10**	**23**	**11**	
2.01	Transportation systems	120		96	32	32	32		24	5			
2.02	ITS management	120		96	48	48			24	5			
2.03	Required elective Module	160		128	48	48	32		32		6		
2.04	Traffic modeling and simulation	140		112	32	48	32	CW	28		6		
2.05	Telecommunication	100		80	48		32		20		4		
2.06	Specialization in ITS I and II	180		144	48	48	48		36		4	3	
2.07	GIS for Transportation	120		96	32	32	32		24			5	
2.08	Traffic safety	160		128	48	32	48	CP	32		3	3	
3	**Selected subjects (Electives)**	**230**	**15**	**172**	**68**	**88**	**16**		**43**	**0**	**2**	**6**	
3.01	Methods of teaching special subjects	90		60	20	40			15			3	
3.02	Mathematical tools	80		64	32	32			16			3	
3.03	Automated Data Acquisition and Processing	60		48	16	16	16		12		2		
	Total	**1781**	**100**	**1472**	**540**	**628**	**304**		**436**	**19**	**29**	**18**	
4	**Scientific activity**	**2430**		**1808**					**892**	**17**	**7**	**18**	**36**
4.01	Research work and preparation of master's thesis	1701		1260					441	14	5	12	20
4.02	Scientific-pedagogical work	341		260					81	3	2	6	-
4.03	Internship	389		288					101				16
	ALL	**4212**		**3280**					**1328**	**36**	**36**	**36**	**36**

4. Disciplinary abstracts

INTELLIGENT TRANSPORT SYSTEMS

Content: General knowledge and broad understanding of the use of ITS in different modes of transport (conditions and processes, dependencies). Recent advances, similarities and differences in ITS across modes of transport. Areas of application of ITS (traffic management; information support for road users; electronic payments and toll collection; extended driver assistance and collision avoidance; commercial and freight vehicle operation, etc.). The main tasks of the creation of ITS on the railway. Structure of IHS on the railway. Legal aspects of ITS.

Objective: To acquire knowledge of the telematics systems currently in use in various modes of transport, taking into account their role in improving efficiency and traffic safety, as well as providing the information necessary for the analysis and design of ITS.

Results of the discipline: knowledge of basic concepts, approaches and models used in the course of planning the movement and functioning of logistics systems; ability to identify information and telecommunication technologies that can help to achieve the goal in terms of

efficiency, safety, customer satisfaction and environmental impact; ability to describe the functions, impact, advantages and disadvantages of the most important ITS-applications.

SYSTEMIC ANALYSIS, MODELING AND OPTIMIZATION OF PROCESSES IN THE TASKS OF THE

Content: The basic concepts of the theory of systems and system analysis (SA) with reference to the problems of intelligent transport systems (ITS) research are disclosed. Well structured, unstructured and poorly structured problems are described. The theory of operations research (OR), control theory and CA are linked. The methodology of decision making in CA, which takes into account the participants of the study, procedures for analysis and synthesis of complex systems in their functioning, the need for forecasting for a significant period of time, the factors of multicriteria, uncertainty conditions, the requirements for the construction and analysis of mathematical models, as well as the search for optimal solutions. Models (flows in networks of transport and information systems, Petri nets, theory of mass service), methods (mathematical programming, simulation modeling, theory of decision making, fuzzy control) and software for realization of CA elements in tasks of analysis and formation of intellectual control for ITS are studied.

Objective: To obtain the basics of theoretical knowledge and skills in the use of methodology, models, methods and tools of CA and EMB to solve problems of justification and optimal selection of complex projects (implementation options), as applied to the design of elements of ITS. Study of the essence, formalization and CA of the main tasks for the implementation of intellectual management in ITS.

Results of mastering the discipline: knowledge of basic concepts, methodology, methods and means of CA and IA at substantiation and choice of complex projects, with reference to designing, modeling and optimization of procedures of intellectual management in ITS; knowledge of peculiarities of carrying out of multi-criteria analysis of systems taking into account various types of uncertainty; ability to carry out CA procedure of various subsystems and processes of ITS, to define categories of models and methods at formalization of tasks of choice of complex projects.

EXPANDED ENGLISH

Content: Development and improvement of language and oral and written communication skills required for professional communication within the framework of scientific and professional topics.

Objective: To develop and improve students' ability to communicate successfully in English, with an emphasis on conversation and understanding of spoken language.

The results of the development of the discipline: Knowledge of different types and forms of control, contributing to the formation of adequative self-assessment, stimulating and mobilizing for successful cam. ability to understand lectures in English and have an opportunity to make notes; be able to actively participate in the discussion going in the English language, introducing new ideas and point of view; be able to select and generalize the most important moments of discussion or lecture; own the skills of structuring and representing information properly; own the creative methods

POSITIONING TECHNOLOGIES IN RAILWAY TRANSPORT

Content: Methods for determining positions using satellite technologies (GPS, GLONASS, GALILEO, etc.). Application and use of satellite technologies and other navigation techniques in four modes of transport. Positioning in cellular networks. Solutions based on WiFi. Local positioning systems. Positioning systems using radio frequency identifiers (RFID) - tags. Selected topics: vehicle positioning, GIS, database, recognition and tracking. Positioning technologies of objects in railway ITS.

Objective: To provide theoretical and practical knowledge of various positioning technologies.
The results of the development of the discipline: the knowledge of the most advanced positioning systems and their key characteristics; knowledge of the advantages and disadvantages of the satellite positioning systems and their restrictions, and also the opportunities for the use of the satellite positioning systems on various transport types; skills to determine and explain measures that are important for positioning and how they are measured in various positioning systems; property owning the skills of the problems in the development of geo-information products: what is the necessary

DEVELOPMENT OF EXPERT AND INTELLECTUAL SYSTEMS

Content: peculiarities and spheres of application of intellectual (IS) and expert systems (ES) are considered, their use for decision making tasks, when high complexity of the field of automation requires the use of expert knowledge, there is a weak structure and conditions of uncertainty (incompleteness, non-determinism, ambiguity, etc.). The basic architectures of IS and ES, models, methods and means of their design and creation, methods and means of obtaining and formalizing expert information, strategies of conclusions conclusion conclusion conclusion; models and technologies of knowledge representation; heuristic, evolutionary and search strategies of collective intellect; fuzzy, neural and neuro-fuzzy systems (Mamdani, Takagi-Sugeno, logical type) are defined. Specialized software tools used for effective implementation of intellectual and expert systems are being studied.
Objective: to obtain theoretical knowledge and skills in analysis, formal modeling of decision-making tasks for various types of uncertainty and areas of application of intellectual and expert systems, formation of skills of IS and ES implementation by modern intellectual software.
The results of the development of the discipline: knowledge of the methods and means of theory of ip and expert systems in the formal description of the objectives; knowledge of research methods of objectives with the purpose of selecting rational and reliable methods of developing ip and es; the skill of location

INTELLIGENT TECHNOLOGIES IN CONTROL SYSTEMS

Content: formation of skills and abilities to solve design and management problems on the basis of artificial intelligence methods, skills of software development for modern intellectual systems; study of methods and software development tools of intellectual systems for various purposes, analysis of real problems, application of intellectual systems to solve problems by means of expert systems, decision support systems
Purpose: To study the models of representation and processing of knowledge in intellectual systems, methods of construction of logical, production, network models and their use in intellectual systems of different purposes.
Results of the discipline: Knowledge of the state and prospects of development of artificial intelligence systems; logical models of representation and processing of knowledge in intellectual systems; ability to use software and pragmatic approach to solving problems of artificial intelligence, intellectual programs; master methods of intellectual programming of control systems.

COMPUTER NETWORKS AND INFORMATION SECURITY

Content: It covers issues related to computer network architecture, data transmission protocols, standards, applications, administration, as well as information security and protection.
Objective: To develop knowledge and skills in the field of network standards of information presentation, data transfer protocols and principles of their use.
Results of mastering the discipline: knowledge of the physical and logical structure of computer networks; knowledge of the basic types of protocols; ability to compare and explain the areas of application of various applications and transport protocols; knowledge of the basic

functions and modern technologies to achieve network security; ability to find compromises between different communication technologies and systems; ability to apply models and methods for planning and configuring the functioning of different types of networks.

TRAFFIC SAFETY MANAGEMENT

Content: The theory of safety, reliability and its interrelationship with traffic safety are outlined, the reasons for the violation of traffic safety are considered, and the conditions contributing to the improvement of traffic safety are considered. Vehicle safety. Moving security. ITS in the field of railway traffic safety. The course considers a set of control mechanisms and effective programs to improve the level of traffic safety based on the use of modern methodological approaches, models and methods, requirements for technical means of train traffic control to ensure the necessary level of safety, proof of functional safety and certification of technical systems.

Objective: to study the organization of traffic safety activities, the fundamentals of train traffic safety, requirements for technical means of train traffic control to ensure the required level of safety, the allocation and justification of priority areas in this area to address a set of tasks in the allocated areas.

Results of the discipline: Knowledge of new technologies in the field of traffic safety management, safe operation of vehicles; ability to apply in practice modern approaches, methods and models of increasing the level of traffic safety; mastery of skills, management of the system of traffic safety, based on the improvement of legal and regulatory activities in the field of traffic safety.

LOGISTICS AND MULTIMODAL SYSTEMS AND SYSTEMS

Content: geo-economic and geopolitical prerequisites for the development of multimodal transport and logistics systems. Basic concepts and methods of logistics. Management in logistics systems. Systemic analysis of logistics processes. Principles of efficient logistics. The essence of multimodal transport and transport logistics. Fundamentals of multimodal transport theory and practice. Organization, implementation conditions, technical means and technologies of multimodal transportation. Concepts of transport logistics. Methods of optimization of transport and logistics systems. Transport and technological cargo delivery systems.

Objective: to study the rational organization of technological processes, which include transportation, storage, storage, packaging of goods, their effective delivery to the end user and to determine the most optimal ways and means of implementation of these processes.

Results of discipline development: knowledge of the transport system structure and the characteristics of the types of transport; knowledge of transport process management methods; knowledge of the rules for interaction of transport types and technology of organization and management of multimodal transport; skills to analyze the condition of transport systems and organize cargo transportation with the interaction of transport types; skill optimize transport and terminal processes; ownership receptions of modeling transport processes by optimization methods of mutual processes

METHODS OF PATTERN RECOGNITION AND DATA MINING IN TASKS

Content: Various mathematical methods and algorithms of data mining are considered: classification, clustering, regression, time series prediction, association, sequence. Various IAM intellectual tools: neural networks, decision trees, inductive inferences, analogous reasoning methods, fuzzy logic inferences, genetic algorithms, association and sequence determination algorithms, selective analysis, logical regression, evolutionary programming, data visualization.

Objective: To study fundamental concepts and methods of recognition. Formation of an understanding of the types of tasks arising in the field of data mining and methods of their

solution, which will help to identify, formalize and successfully solve practical problems of data mining.

Results of mastering the discipline: knowledge of the main tasks and methods of recognition of methods and intellectual analysis of data; ability to formulate tasks of pattern recognition and data analysis, to choose adequate algorithms of their solution, to evaluate the quality of the obtained solutions; mastery of the technologies of development of algorithms and software systems of pattern recognition and data analysis.

WIRELESS AND MOBILE COMMUNICATIONS

Content: Description of the principles of mobile communications. The basics of radio transmission. Sealing. Spectrum expansion. Global wireless mobile networks: 2G GSM. Overview of the GSM system. Mobile services. System architecture. Radio interface. Protocols. Localization and calls. Security. 2G Evolution: GPRS. Overview of the GPRS system. GPRS functions. WLAN: 802.1 standard. Introduction. WLAN architecture. Protocols. MAC Management. WLAN protection.

Purpose: To give theoretical and practical skills in working with wireless networks of 802.11a/b/d family of standards.

Results of the discipline: knowledge of different mobile communication systems, their important components and functions; knowledge of the role of mobile communication systems in different areas of application; ability to evaluate trade-offs between different technologies and mobile communication systems; ability to evaluate the performance of various mobile network technologies, given a set of basic performance characteristics; ability to apply models and methods for mesh network design; ability to identify and calculate basic key metrics produces

GEOINFORMATION SYSTEMS FOR TRANSPORT

Content: basic concepts of GIS. Organization of information in GIS, presentation of graphic and thematic information in GIS. Geographical databases, cartographic representation, geographical analysis. Instrumental GIS. Application of GIS on the railway: real estate management, management of infrastructure facilities (power supply, track facilities, signaling and communication), train and cargo tracking, cargo flow analysis, monitoring and response to emergency situations, passenger information, marketing, risk assessment, network development planning, distribution of funds for repair and development.

Objective: To provide knowledge of geographic information systems and their principles. Build in-depth knowledge of geographic information systems for ITS engineers.

Results of the discipline: Knowledge of basic geographic information technologies; knowledge of the most important GIS applications in traffic and transport planning; understanding of the purpose of GIS applications; ability to independently work with GIS programs, conduct analysis and present results in structured reports.

TELEMATICS, INTEROPERABILITY AND INFORMATION TECHNOLOGIES OF RAILWAYS

Content: formation of knowledge of service standards, architecture, telematics, interoperability requirements, main properties and types of intellectual transportation (intellectual cargo, tracking, etc.), technologies of intellectual railway transport systems (ITSG): intellectual train, locomotive, station, etc. The main categories of tasks of cooperative management of objects are studied, as well as some mathematical models of tasks of diagnostics and formation of intellectual management for ITSG (models of Petri nets, clustering, Kohonen neural networks, Hopfield, etc.).

Purpose: To obtain basic concepts and theoretical knowledge in the field of standards of architecture, services, essence, structure and means of implementation of telematic management in railway ITS; to study the basic categories of tasks of cooperative interaction of objects, as well

as the formation of models of intellectual management in railway ITS.
The results of the development of the discipline: knowledge of the purpose and basic concepts of the standards for services, architecture, telematics, interoperability requirements, the basic properties of intelligent transport; structures and categories of tasks of cooperative management of objects; mathematical models of the problems of diagnosing and forming intellectual control for its; ability to apply standards (services, telematics and others) when estimating quality and designing its elements; determine the category of mathematical models and methods, implement the procedures

APPLIED MODELING AND OPTIMIZATION OF CONTROL PROCESSES IN THE ISPS

Content: The course reveals the role of mathematical control theory in the study of controlled dynamic systems. The analysis of the content of the applied tasks of the theory of optimal management, their formulation and examples of solutions is carried out. Application of mathematical models for construction of the automated control systems of transport technological processes and the decision of problems of optimization of structure and parameters of systems is considered.

Objective: to develop advanced professional knowledge in the field of optimal management theory.
Results of the discipline: Knowledge of the methods of solving the problems of the theory of control and theory of optimal control for the systems given by the equations in the space of states; methods of finding the optimal control of dynamic systems, the scope of application of these methods; ability to apply the criteria of complete controllability and complete observability of linear stationary controlled systems, to find the optimal control for different systems; mastery of the methods of investigation of controlled dynamic systems and finding the optimal control of these systems.

ERGATIC SYSTEMS OF RAILWAY TRANSPORT IN THE CONDITIONS OF THE

Content: comprehensive study of people in the conditions of their labor activity, related to the use of machines or mechanisms to improve the efficiency of the functioning of such systems by optimizing the means, conditions and process of work. Features of ergonomic control systems (ESM). Engineering and psychological problems of creation and operation of ESAs. Specifics of analysis and synthesis of ESAs. Typical contradictions resolved in the process of creating new ESAs.
Objective: to improve the efficiency of ergonomic systems.
Results of mastering the discipline: knowledge of the role of human cognitive processes in the interaction between people and technical systems; ability to formulate methods of interaction between people and technical systems and methods of their evaluation; ability to formulate the expediency of the criteria of convenience and ease of use in creating technical systems.