# Study plan

# Name of study plan: navaz. mag. PRE program IS v EN 21/22 (nová akreditace)

Faculty/Institute/Others: Department: Branch of study guaranteed by the department: Welcome page Garantor of the study branch: Program of study: Intelligent Transport Systems Type of study: Follow-up master full-time Required credits: 120 Elective courses credits: 0 Sum of credits in the plan: 120 Note on the plan:

Name of the block: Semestrální projekt Minimal number of credits of the block: 27 The role of the block: ZP

Code of the group: XN IS EN 1-4 21/22 Name of the group: Projekty nav.prez.1.-4.sem (od) 21/22 programu IS v EN Requirement credits in the group: In this group you have to gain 27 credits Requirement courses in the group: In this group you have to complete 4 courses Credits in the group: 27 Note on the group:

Note on the g						
Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
11XN1S-E	Master project 1 for study programme IS Evženie Uglickich, Bohumil Ková, Jan P ikryl Bohumil Ková Evženie Uglickich (Gar.)	Z	5	0P+4C	z	ZP
12XN1S-E	Master project 1 for study programme IS	Z	5	0P+4C	Z	ZP
14XN1S-E	Master project 1 for study programme IS	Z	5	0P+4C	Z	ZP
15XN1S-E	Master project 1 for study programme IS	Z	5	0P+4C	Z	ZP
16XN1S-E	Master project 1 for study programme IS David Lehet, Tereza Kunclová	Z	5	0P+4C	Z	ZP
17XN1S-E	Master project 1 for study programme IS	Z	5	0P+4C	Z	ZP
18XN1S-E	Master project 1 for study programme IS	Z	5	0P+4C	Z	ZP
20XN1S-E	Master project 1 for study programme IS	Z	5	0P+4C	Z	ZP
21XN1S-E	Master project 1 for study programme IS	Z	5	0P+4C	Z	ZP
22XN1S-E	Master project 1 for study programme IS	Z	5	0P+4C	Z	ZP
23XN1S-E	Master project 1 for study programme IS	Z	5	0P+4C	Z	ZP
11XN2S-E	Master project 2 for study programme IS Evženie Uglickich, Bohumil Ková, Jan Pikryl Jan Pikryl Jan Pikryl (Gar.)	Z	6	0P+4C	L	ZP
12XN2S-E	Master project 2 for study programme IS	Z	6	0P+4C	L	ZP
14XN2S-E	Master project 2 for study programme IS	Z	6	0P+4C	L	ZP
15XN2S-E	Master project 2 for study programme IS	Z	6	0P+4C	L	ZP
16XN2S-E	Master project 2 for study programme IS	Z	6	0P+4C	L	ZP
17XN2S-E	Master project 2 for study programme IS	Z	6	0P+4C	L	ZP
18XN2S-E	Master project 2 for study programme IS	Z	6	0P+4C	L	ZP
20XN2S-E	Master project 2 for study programme IS	Z	6	0P+4C	L	ZP
21XN2S-E	Master project 2 for study programme IS	Z	6	0P+4C	L	ZP
22XN2S-E	Master project 2 for study programme IS	Z	6	0P+4C	L	ZP
23XN2S-E	Master project 2 for study programme IS	Z	6	0P+4C	L	ZP
11XN3S-E	Master project 3 for study programme IS	Z	6	0P+4C	Z	ZP

12XN3S-E	Master project 3 for study programme IS	Z	6	0P+4C	Z	ZP
14XN3S-E	Master project 3 for study programme IS	Z	6	0P+4C	Z	ZP
15XN3S-E	Master project 3 for study programme IS	Z	6	0P+4C	Z	ZP
16XN3S-E	Master project 3 for study programme IS	Z	6	0P+4C	Z	ZP
17XN3S-E	Master project 3 for study programme IS	Z	6	0P+4C	Z	ZP
18XN3S-E	Master project 3 for study programme IS	Z	6	0P+4C	Z	ZP
20XN3S-E	Master project 3 for study programme IS	Z	6	0P+4C	Z	ZP
21XN3S-E	Master project 3 for study programme IS	Z	6	0P+4C	Z	ZP
22XN3S-E	Master project 3 for study programme IS	Z	6	0P+4C	Z	ZP
23XN3S-E	Master project 3 for study programme IS	Z	6	0P+4C	Z	ZP
11XN4S-E	Master project 4 for study programme IS	Z	10	0P+8C	L	ZP
12XN4S-E	Master project 4 for study programme IS	Z	10	0P+8C	L	ZP
14XN4S-E	Master project 4 for study programme IS	Z	10	0P+8C	L	ZP
15XN4S-E	Master project 4 for study programme IS	Z	10	0P+8C	L	ZP
16XN4S-E	Master project 4 for study programme IS	Z	10	0P+8C	L	ZP
17XN4S-E	Master project 4 for study programme IS	Z	10	0P+8C	L	ZP
18XN4S-E	Master project 4 for study programme IS	Z	10	0P+8C	L	ZP
20XN4S-E	Master project 4 for study programme IS Martin Leso	Z	10	0P+8C	L	ZP
21XN4S-E	Master project 4 for study programme IS	Z	10	0P+8C	L	ZP
22XN4S-E	Master project 4 for study programme IS	Z	10	0P+8C	L	ZP
23XN4S-E	Master project 4 for study programme IS	Z	10	0P+8C	L	ZP

# Characteristics of the courses of this group of Study Plan: Code=XN IS EN 1-4 21/22 Name=Projekty nav.prez.1.-4.sem (od) 21/22 programu IS v EN\_\_\_\_\_

programu is v E			
11XN1S-E	Master project 1 for study programme IS	Z	5
12XN1S-E	Master project 1 for study programme IS	Z	5
14XN1S-E	Master project 1 for study programme IS	Z	5
15XN1S-E	Master project 1 for study programme IS	Z	5
16XN1S-E	Master project 1 for study programme IS	Z	5
17XN1S-E	Master project 1 for study programme IS	Z	5
18XN1S-E	Master project 1 for study programme IS	Z	5
20XN1S-E	Master project 1 for study programme IS	Z	5
21XN1S-E	Master project 1 for study programme IS	Z	5
22XN1S-E	Master project 1 for study programme IS	Z	5
23XN1S-E	Master project 1 for study programme IS	Z	5
11XN2S-E	Master project 2 for study programme IS	Z	6
12XN2S-E	Master project 2 for study programme IS	Z	6
14XN2S-E	Master project 2 for study programme IS	Z	6
15XN2S-E	Master project 2 for study programme IS	Z	6
16XN2S-E	Master project 2 for study programme IS	Z	6
17XN2S-E	Master project 2 for study programme IS	Z	6
18XN2S-E	Master project 2 for study programme IS	Z	6
20XN2S-E	Master project 2 for study programme IS	Z	6
21XN2S-E	Master project 2 for study programme IS	Z	6
22XN2S-E	Master project 2 for study programme IS	Z	6
23XN2S-E	Master project 2 for study programme IS	Z	6
11XN3S-E	Master project 3 for study programme IS	Z	6
12XN3S-E	Master project 3 for study programme IS	Z	6
14XN3S-E	Master project 3 for study programme IS	Z	6
15XN3S-E	Master project 3 for study programme IS	Z	6
16XN3S-E	Master project 3 for study programme IS	Z	6
17XN3S-E	Master project 3 for study programme IS	Z	6
18XN3S-E	Master project 3 for study programme IS	Z	6
20XN3S-E	Master project 3 for study programme IS	Z	6
21XN3S-E	Master project 3 for study programme IS	Z	6
22XN3S-E	Master project 3 for study programme IS	Z	6
23XN3S-E	Master project 3 for study programme IS	Z	6
11XN4S-E	Master project 4 for study programme IS	Z	10
12XN4S-E	Master project 4 for study programme IS	Z	10
14XN4S-E	Master project 4 for study programme IS	Z	10

15XN4S-E	Master project 4 for study programme IS	Z	10
16XN4S-E	Master project 4 for study programme IS	Z	10
17XN4S-E	Master project 4 for study programme IS	Z	10
18XN4S-E	Master project 4 for study programme IS	Z	10
20XN4S-E	Master project 4 for study programme IS	Z	10
21XN4S-E	Master project 4 for study programme IS	Z	10
22XN4S-E	Master project 4 for study programme IS	Z	10
23XN4S-E	Master project 4 for study programme IS	Z	10

Name of the block: Compulsory courses Minimal number of credits of the block: 93 The role of the block: Z

Code of the group: 1.S.NPIS EN 21/22

Name of the group: 1.sem.nav.prez (od) 21/22 - program IS v EN Requirement credits in the group: In this group you have to gain 22 credits Requirement courses in the group: In this group you have to complete 5 courses Credits in the group: 22

Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
11MAI-E	ITS Mathematical Tools Jan P ikryl Jan P ikryl Jan P ikryl (Gar.)	Z,ZK	4	2P+2C	Z	Z
16DITS-E	Vehicles within ITS David Lehet, Jaroslav Machan	Z,ZK	4	2P+2C	Z	Z
20GINS-E	Geographical, information, localization and navigation systems Petr Bureš, František Kekula, Pavel Hrubeš, Zuzana Purkrábková	Z,ZK	6	3P+3C	Z	Z
20TSJ-E	Telematic systems and their design Petr Bureš, Ond ej P ibyl	Z,ZK	6	3P+2C	Z	Z
23TBSS-E	Technology and Security of Sensor Networks Václav Jirovský Václav Jirovský Václav Jirovský (Gar.)	KZ	2	2P+0C	Z	Z

## Characteristics of the courses of this group of Study Plan: Code=1.S.NPIS EN 21/22 Name=1.sem.nav.prez (od) 21/22 - program IS v

11MAI-E	ITS Mathematical Tools	Z,ZK	4				
Series, Fourier Series. Discrete Fourier Transform. Segmentation of signals, windows, localization. Short-term Fourier Transform. From Fourier Analysis to PDE. Fundamentals of							
Numerical Mathematics. Numerical solutions to ODEs and PDEs. Continuous traffic flow models described by PDE. Car-following models as ODEs.							
16DITS-E	Vehicles within ITS	Z,ZK	4				
Design of the vehicle with focus on its use and function in frame of ITS. User requirement analyses. Economic aspects. Process of constructions in a concept phase, functional							
dependences and struct	ure of the designed object. Creation of functional models. Energy management and storages for ground vehicles, energy trai	nsformations lead	ling to kinetic				
one. Propulsion systems	/ traditional and alternative ones. Life-cycle analysis.						
20GINS-E	Geographical, information, localization and navigation systems	Z,ZK	6				
The subject is specialized	I in problems of work with applications of geographic information systems with special attention to the specialization in the field of	transport and tele	ecommunication.				
It introduces students to	geographic data management practices and tools, real world modeling, geographic data storage models, data entry and dig	itization methods	, and a number				
of other GIS related tech	nologies such as problem mapping, webmap, etc.						
20TSJ-E	Telematic systems and their design	Z,ZK	6				
Gradual detailed analysi	s of individual existing telematics systems in modes of transport, such as toll systems, vehicle weighing, fleet management,	traffic manageme	nt, etc.				
23TBSS-E	Technology and Security of Sensor Networks	KZ	2				
The course focuses on the	The course focuses on the safety of data collection in new areas of sensor networks. Principles of sensor networks, sensors of electrical and non-electric quantities, interfaces for						
sensor connection, comr	nunication technology for sensor networks, SigFox, LoRa, NB-IoT, IoT technology and SmartCity. Trends in IoT and Smart C	ity					

### Code of the group: 1.S.NPIS VYBEN 21/22

Name of the group: 1.sem.nav.prez (od) 21/22 výb r p edm tu - program IS v EN Requirement credits in the group: In this group you have to gain 3 credits Requirement courses in the group: In this group you have to complete 1 course Credits in the group: 3

Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
12TDP-E	Traffic Flow Theory Vladimír Faltus	Z,ZK	3	2P+1C	Z	Z

16ESDP-E	Electronic systems in modern vehicles Dmitrij Rožd stvenský, Petr Bouchner	Z,ZK	3	2P+1C	Z	Z
20MZZ-E	Modern techniques of safety control of moving railway vehicles Martin Leso	Z,ZK	3	2P+1C	Z	Z

# Characteristics of the courses of this group of Study Plan: Code=1.S.NPIS VYBEN 21/22 Name=1.sem.nav.prez (od) 21/22 výb r p edm tu - program IS v EN

12TDP-E	Traffic Flow Theory	Z,ZK	3				
Mobility and associated human problems. Basic traffic parameters and their measurement. Estimation of quality of services. Theoretical fundamentals and applications of mathematical							
models. Macroscopic, s	models. Macroscopic, statistical and microscopic models. Theory of shock waves, queuing theory and special theory of traffic phenomena. Relation between traffic models and traffic						
flow management.							
16ESDP-E	Electronic systems in modern vehicles	Z,ZK	3				
Advanced vehicle syste	ms, electromobility, V2I and V2V, autonomous driving. Combustion engine control and electronic control units. Electric propul	sion, its compone	nts, basic				
characteristics and cont	rol. Management of hybrid propulsion for attaining its optimal efficiency. Vehicle communication bus (CAN, LIN, FlexRay etc.)	. Safety, commun	ication and				
comfort electronic vehic	le systems. Practical exercises with real and simulated systems.						
20MZZ-E	Modern techniques of safety control of moving railway vehicles	Z,ZK	3				
ERTMS / ETCS concepts, ETCS architecture and interface descriptions, ERTMS system level, infrastructure and mobile part of the system, linking to stationary security systems,							
operating and application	on modes of the system, infrastructure orientation, interface (DMI), integration of the ETCS mobile part into the driving vehicle	e, GSM-R function	nal specification,				
testing and legislation.							

# Code of the group: 2.S.NPIS EN 21/22

### Name of the group: 2.sem.nav.prez (od) 21/22 - program IS v EN Requirement credits in the group: In this group you have to gain 21 credits Requirement courses in the group: In this group you have to complete 5 courses Credits in the group: 21

Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
14CITS-E	<b>C-ITS Systems</b> Zden k Lokaj, Tomáš Zelinka, Miroslav Vaniš <b>Zden k Lokaj</b> Zden k Lokaj (Gar.)	Z,ZK	6	3P+3C	L	Z
14PAM-E	<b>Programming and modelling</b> Vít Fábera, Tomáš Brandejský, Marek Kalika, Martin Fiala <b>Vít Fábera</b> Vít Fábera (Gar.)	Z,ZK	4	2P+2C	L	Z
14PD-E	Data processing Miroslav Vaniš, Martin Šrotý <b>Michal Je ábek</b> Michal Je ábek (Gar.)	Z,ZK	6	2P+4C	L	Z
14PPRP-E	Computer Aided Project Management Marek Kalika Marek Kalika Marek Kalika (Gar.)	KZ	2	0P+2C	L	Z
20BITS-E	Safety and reliability of ITS Systems Vladimír Faltus, Tomáš Tichý Tomáš Tichý (Gar.)	KZ	3	2P+1C	L	Z

#### Characteristics of the courses of this group of Study Plan: Code=2.S.NPIS EN 21/22 Name=2.sem.nav.prez (od) 21/22 - program IS v

EN			
14CITS-E	C-ITS Systems	Z,ZK	6
Detailed description of 0	C-ITS systems architecture, description of use-cases - urban and rural applications, principles of C-ITS funcionality with focus	on data exchang	je (CAM, DENM,
IVI) and C-ITS security	architecture. Status quo and modern trends of wireless telecommunication solutions ITS-G5 and LTE-V and description of its	properties and s	pecifics. Course
will also cover signal pro	ocessing.		
14PAM-E	Programming and modelling	Z,ZK	4
Object oriented program	ming, dynamic memory allocation, inheritage, generic programming, STL, abstract data types, programming techniques, rec	ursion, complexit	y, Lindenmeyer's
grammars, paralism in r	nature and in real systems, paralel computer systems, paralel programming, discrete simulation, models of processes, model	l types As-Is a To-	-Be, acquisition
of analytical sources for	modelling, BPMN language, SW Bizagi, model creation and life cycle.		
14PD-E	Data processing	Z,ZK	6
Students will learn abou	it tools for data processing and analysis, using practical examples to try out the most common options used in data processir	ng, including adva	anced options for
presenting the results o	f analyses. In advanced methods, students will also perform specific analysis using Bayesian networks. Students will then inc	lependently perfo	rm data analysis
on data from existing op	en systems.		
14PPRP-E	Computer Aided Project Management	KZ	2
What is the project? The	e basic terms a concepts of project management. Life cycle of the project and its phased approach. Analysis and specificatio	n of the assignme	ent, activity
definition, stages, objec	tives and measurability. Risk events and risk planning. Project change management during implementation. Preparation of th	e project outline (	(activities,
restrictions, assignment	s, calendars etc.) Project planning and optimization - time, resources.		
20BITS-E	Safety and reliability of ITS Systems	KZ	3
The basic concepts of s	afety and reliability in the job and application. Basic schema and types of diagnostic systems including reliability diagnostics	of technical equip	oment and ITS.
Investigation of accepta	bility and reliability prediction, traffic crity and sensitivity analysis. Neural Networks and other optimization algorithms and ET/	A, FMEA failure a	nalysis. HMI in
traffic including operator	r testing on simulator and in real-world situatiation		

Code of the group: 2.S.NPIS VYBEN 21/22

Name of the group: 2.sem.nav.prez (od) 21/22 výb r p edm tu - program IS v EN Requirement credits in the group: In this group you have to gain 3 credits

### Requirement courses in the group: In this group you have to complete 1 course Credits in the group: 3 Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
14MIM-E	Microsimulation Models Jan Mejst ík Jan Mejst ík Jan Mejst ík (Gar.)	KZ	3	0P+3C	L	Z
16SHMI-E	Simulation and HMI Tereza Kunclová, Petr Bouchner, Stanislav Novotný, Michal Cenkner Stanislav Novotný (Gar.)	Z,ZK	3	2P+1C	L	z
20ITSR-E	ITS - R Martin Leso Martin Leso (Gar.)	Z,ZK	3	2P+1C	L	Z

# Characteristics of the courses of this group of Study Plan: Code=2.S.NPIS VYBEN 21/22 Name=2.sem.nav.prez (od) 21/22 výb r p edm tu - program IS v EN

14MIM-E Microsim	nulation Models	KZ	3
Basic knowledge of traffic modeling	and simulation will be broaded by the application of traffic control algorithms to traffic microsimulation models us	ed in ITS. These	include, for
example, the proposal of algorithms	for actuated signal control, pedestrian preference, dynamic network routing, road line traffic control, crossing secu	rity equipment, an	d PT preference.
Algorithms will be designed, applied	l, and tested by students themselves.		
16SHMI-E Simulation	on and HMI	Z,ZK	3
Simulation for the systems in transpo	ortation and vehicle systems. User interface, HMI (human-machine interaction), virtual reality and computer graph	nics for ITS. Simul	ation theory with
application of computing equipment	. Creating computing models. Mechanic and dynamic systems and their mathematical models. Simulation of vehi	icle dynamics, on-	land carriage in
particular. Virtual reality systems.			
20ITSR-E ITS - R		Z,ZK	3
The introduction is devoted to descr	iption of the architecture and interface of the system with the ITS-R concept, the communication interface of the	system, principles	s of ensuring
functional and security features are o	defined. The principles of ERTMS / ETCS application level 3, UGTMS, CBTC are discussed in detail. Current and fi	uture communicat	ion technologies
are described.			

#### Code of the group: 3.S.NPIS EN 21/22

Name of the group: 3.sem.nav.prez (od) 21/22 - program IS v EN Requirement credits in the group: In this group you have to gain 21 credits Requirement courses in the group: In this group you have to complete 4 courses Credits in the group: 21 Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
11MMAD-E	Mathematical Methods for Data Analysis Magdalena Hykšová, Ivan Nagy Magdalena Hykšová Magdalena Hykšová (Gar.)	Z,ZK	6	3P+3C	Z	Z
20AIMI-E	Application of ITS in Urban Engineering Tomáš Tichý, Josef Filip, Ji í R ži ka	Z,ZK	6	3P+3C	Z	Z
20SYIN-E	System Engineering Zuzana B linová	Z,ZK	6	4P+2C	Z	Z
20HEI-E	Evaluation and Economics of ITS Jakub Rajnoch	KZ	3	2P+1C	Z	Z

# Characteristics of the courses of this group of Study Plan: Code=3.S.NPIS EN 21/22 Name=3.sem.nav.prez (od) 21/22 - program IS v EN

11MMAD-E	Mathematical Methods for Data Analysis	Z.ZK	6
	imation, prediction, filtration, control, methods of data analysis: k-means, DBSCAN, naive Bayes, decision trees, support vec	tor machine.	-
20AIMI-E	Application of ITS in Urban Engineering	Z,ZK	6
The course focuses mai	nly on the issue of the installation of engineering networks in the area, coordination of engineering activities in the area, organi	zation of the publi	c space, concept
of public space solution	s, design of systems for traffic and transport telematics management, coordination of transport modes - automobil, pedestria	in, MHD, cyclo, m	odes etc. New
approaches to the deve	lopment of Smart and green approaches Promoting into Public.		
20SYIN-E	System Engineering	Z,ZK	6
Enhanced system defin	tion in engineering tasks, specification of selected system types against related tools of system analysis and design, refinen	nent of selected ty	pes of system
engineering tasks, defin	ition of system strategy, connection to science-based methodological basics of transport, strategic thinking processes, strate	egic management	system, context
of sustainable developm	nent.		
20HEI-E	Evaluation and Economics of ITS	KZ	3
Introduction of subject is	e devoted to the basics of system approach to development of ITS architecture and fundamentals in the field of economic attril	, outes connected v	with development
of ITS. Subsequently, th	e basic principles of system and application creation in the technical field are discussed, defining the penetration of the tech	nical solution into	the economy.
The subject is terminate	ed by a detailed breakdown of case studies.		

### Code of the group: 3.S.NPIS VYBEN 21/22 Name of the group: 3.sem.nav.prez (od) 21/22 výb r p edm tu - program IS v EN

### Requirement credits in the group: In this group you have to gain 3 credits Requirement courses in the group: In this group you have to complete 1 course Credits in the group: 3 Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
16KSD-E	Quality and reliability in area of transportation means and systems David Lehet, Jaroslav Machan	Z,ZK	3	2P+1C	Z	Z
20PRZP-E	Computer aided railway traffic control Dušan Kamenický	Z,ZK	3	2P+1C	Z	Z
20TVHD-E	Telematics in Public Transport Milan Sliacky	Z,ZK	3	2P+1C	Z	Z

# Characteristics of the courses of this group of Study Plan: Code=3.S.NPIS VYBEN 21/22 Name=3.sem.nav.prez (od) 21/22 výb r p edm tu - program IS v EN

16KSD-E	Quality and reliability in area of transportation means and systems	Z,ZK	3
Quality methods used for	or design, manufacturing and operation. Methods QFD, DFM, DFA, DFS. Longtime testing. FMEA method. Operation reliabilit	y. Methods for pro	cess optimizing,
process design and qua	lity improvement (Six Sigma etc.). Certification and accreditation, quality management, tools and methods for quality stabiliz	ation and improve	ement. Students
will work on real probler	ns in the QFD laboratory.		
20PRZP-E	Computer aided railway traffic control	Z,ZK	3
Introduction is devoted	o clarifying the reasons and basic principles of automation of the management of railway transport. It explains the structure	of railway traffic m	anagement,
including the main princ	iples applied in the management of railway traffic. The main part is devoted to detailed description of the individual compone	nts of the system	, which must be
included in the systems	for automation of railway traffic control using computer technologies.		
20TVHD-E	Telematics in Public Transport	Z,ZK	3
Ticketing and informatio	n systems; foreinght experiences; vehicle technology; dispatching systems; Information Systems; data structures; clearing; Pu	blic Transport pre	ferences; vehicle
position monitoring; legi	slative framework; standardization, certification and interoperability.		

### Code of the group: XNDP IS 21/22 EN

Name of the group: Diplomová práce program IS EN (od) 21/22 Requirement credits in the group: In this group you have to gain 16 credits Requirement courses in the group: In this group you have to complete 1 course Credits in the group: 16 Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
11XNDS-E	Master Thesis for study programme IS	Z	16	0P+16C	L	Z
12XNDS-E	Master Thesis for study programme IS	Z	16	0P+16C	L	Z
14XNDS-E	Master Thesis for study programme IS	Z	16	0P+16C	L	Z
15XNDS-E	Master Thesis for study programme IS	Z	16	0P+16C	L	Z
16XNDS-E	Master Thesis for study programme IS	Z	16	0P+16C	L	Z
17XNDS-E	Master Thesis for study programme IS	Z	16	0P+16C	L	Z
18XNDS-E	Master Thesis for study programme IS	Z	16	0P+16C	L	Z
20XNDS-E	Master Thesis for study programme IS Martin Leso	Z	16	0P+16C	L	Z
21XNDS-E	Master Thesis for study programme IS	Z	16	0P+16C	L	Z
22XNDS-E	Master Thesis for study programme IS	Z	16	0P+16C	L	Z
23XNDS-E	Master Thesis for study programme IS	Z	16	0P+16C	L	Z

#### Characteristics of the courses of this group of Study Plan: Code=XNDP IS 21/22 EN Name=Diplomová práce program IS EN (od) 21/22

11XNDS-E	Master Thesis for study programme IS	Z	16
12XNDS-E	Master Thesis for study programme IS	Z	16
14XNDS-E	Master Thesis for study programme IS	Z	16
15XNDS-E	Master Thesis for study programme IS	Z	16
16XNDS-E	Master Thesis for study programme IS	Z	16
17XNDS-E	Master Thesis for study programme IS	Z	16
18XNDS-E	Master Thesis for study programme IS	Z	16
20XNDS-E	Master Thesis for study programme IS	Z	16
21XNDS-E	Master Thesis for study programme IS	Z	16
22XNDS-E	Master Thesis for study programme IS	Z	16
23XNDS-E	Master Thesis for study programme IS	Z	16

Code of the group: XPXS IS 21/22 EN Name of the group: Praxe pro program IS EN (od) 21/22 Requirement credits in the group: In this group you have to gain 4 credits Requirement courses in the group: In this group you have to complete 1 course Credits in the group: 4 Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
11XPXS-E	Training course for study programme IS	Z	4	0P+4C	L	Z
12XPXS-E	Training course for study programme IS	Z	4	0P+4C	L	Z
14XPXS-E	Training course for study programme IS	Z	4	0P+4C	L	Z
15XPXS-E	Training course for study programme IS	Z	4	0P+4C	L	Z
16XPXS-E	Training course for study programme IS	Z	4	0P+4C	L	Z
17XPXS-E	Training course for study programme IS	Z	4	0P+4C	L	Z
18XPXS-E	Training course for study programme IS	Z	4	0P+4C	L	Z
20XPXS-E	Training course for study programme IS Ji í R ži ka	Z	4	0P+4C	L	Z
21XPXS-E	Training course for study programme IS	Z	4	0P+4C	L	Z
22XPXS-E	Training course for study programme IS	Z	4	0P+4C	L	Z
23XPXS-E	Training course for study programme IS	Z	4	0P+4C	L	Z

11XPXS-E	Training course for study programme IS	Z	4
12XPXS-E	Training course for study programme IS	Z	4
14XPXS-E	Training course for study programme IS	Z	4
15XPXS-E	Training course for study programme IS	Z	4
16XPXS-E	Training course for study programme IS	Z	4
17XPXS-E	Training course for study programme IS	Z	4
18XPXS-E	Training course for study programme IS	Z	4
20XPXS-E	Training course for study programme IS	Z	4
21XPXS-E	Training course for study programme IS	Z	4
22XPXS-E	Training course for study programme IS	Z	4
23XPXS-E	Training course for study programme IS	Z	4

### List of courses of this pass:

Code	Name of the course	Completion	Credits
11MAI-E	ITS Mathematical Tools	Z,ZK	4
Series, Fourier Ser	ries. Discrete Fourier Transform. Segmentation of signals, windows, localization. Short-term Fourier Transform. From Fourier Analys	is to PDE. Fundan	nentals of
Nun	nerical Mathematics. Numerical solutions to ODEs and PDEs. Continuous traffic flow models described by PDE. Car-following mod	els as ODEs.	
11MMAD-E	Mathematical Methods for Data Analysis	Z,ZK	6
Stocastic r	nodelling, estimation, prediction, filtration, control, methods of data analysis: k-means, DBSCAN, naive Bayes, decision trees, supp	ort vector machine	e.
11XN1S-E	Master project 1 for study programme IS	Z	5
11XN2S-E	Master project 2 for study programme IS	Z	6
11XN3S-E	Master project 3 for study programme IS	Z	6
11XN4S-E	Master project 4 for study programme IS	Z	10
11XNDS-E	Master Thesis for study programme IS	Z	16
11XPXS-E	Training course for study programme IS	Z	4
12TDP-E	Traffic Flow Theory	Z,ZK	3
Mobility and associate	ed human problems. Basic traffic parameters and their measurement. Estimation of quality of services. Theoretical fundamentals an	d applications of m	athematica
models. Macroscopic	c, statistical and microscopic models. Theory of shock waves, queuing theory and special theory of traffic phenomena. Relation bet	ween traffic models	s and traffic
	flow management.		
12XN1S-E	Master project 1 for study programme IS	Z	5
12XN2S-E	Master project 2 for study programme IS	Z	6
12XN3S-E	Master project 3 for study programme IS	Z	6

12XN4S-E	Master project 4 for study programme IS	Z	10
12XNDS-E	Master Thesis for study programme IS	Z	16
12XPXS-E	Training course for study programme IS	Z	4
14CITS-E	C-ITS Systems	Z,ZK	6
-	n of C-ITS systems architecture, description of use-cases - urban and rural applications, principles of C-ITS functionality with focus on		
IVI) and C-ITS seci	urity architecture. Status quo and modern trends of wireless telecommunication solutions ITS-G5 and LTE-V and description of its provide a source size of the second status of th	operties and spec	cifics. Course
	will also cover signal processing.	1/7	2
14MIM-E	Microsimulation Models e of traffic modeling and simulation will be broaded by the application of traffic control algorithms to traffic microsimulation models use		3
	sal of algorithms for actuated signal control, pedestrian preference, dynamic network routing, road line traffic control, crossing security (		
	Algorithms will be designed, applied, and tested by students themselves.	equipment, and r	r preference
14PAM-E	Programming and modelling	Z,ZK	4
	gramming, dynamic memory allocation, inheritage, generic programming, STL, abstract data types, programming techniques, recursi		
	m in nature and in real systems, paralel computer systems, paralel programming, discrete simulation, models of processes, model ty		-
	of analytical sources for modelling, BPMN language, SW Bizagi, model creation and life cycle.		
14PD-E	Data processing	Z,ZK	6
	about tools for data processing and analysis, using practical examples to try out the most common options used in data processing,	-	
resenting the resu	Its of analyses. In advanced methods, students will also perform specific analysis using Bayesian networks. Students will then indepe	endently perform	data analys
	on data from existing open systems.		
14PPRP-E	Computer Aided Project Management	KZ	2
	ect? The basic terms a concepts of project management. Life cycle of the project and its phased approach. Analysis and specification	-	
definition, stage	s, objectives and measurability. Risk events and risk planning. Project change management during implementation. Preparation of th restrictions, assignments, calendars etc.) Project planning and optimization - time, resources.	e project outline	(activities,
		7	<b>-</b>
14XN1S-E	Master project 1 for study programme IS	Z	5
14XN2S-E	Master project 2 for study programme IS	Z	6
14XN3S-E	Master project 3 for study programme IS	Z	6
14XN4S-E	Master project 4 for study programme IS	Z	10
14XNDS-E	Master Thesis for study programme IS	Z	16
14XPXS-E	Training course for study programme IS	Z	4
15XN1S-E	Master project 1 for study programme IS	Z	5
15XN2S-E	Master project 2 for study programme IS	Z	6
15XN3S-E	Master project 3 for study programme IS	Z	6
15XN4S-E	Master project 4 for study programme IS	Z	10
15XNDS-E	Master Thesis for study programme IS	7	16
15XNDS-E	Master Thesis for study programme IS Training course for study programme IS	Z 7	16 4
15XPXS-E	Training course for study programme IS	Z	4
15XPXS-E 16DITS-E	Training course for study programme IS Vehicles within ITS	Z Z,ZK	4
15XPXS-E 16DITS-E Design of the ve	Training course for study programme IS Vehicles within ITS Phicle with focus on its use and function in frame of ITS. User requirement analyses. Economic aspects. Process of constructions in a	Z Z,ZK a concept phase,	4 4 functional
15XPXS-E 16DITS-E Design of the ve	Training course for study programme IS Vehicles within ITS	Z Z,ZK a concept phase,	4 4 functional
15XPXS-E 16DITS-E Design of the ve	Training course for study programme IS Vehicles within ITS shicle with focus on its use and function in frame of ITS. User requirement analyses. Economic aspects. Process of constructions in a structure of the designed object. Creation of functional models. Energy management and storages for ground vehicles, energy trans	Z Z,ZK a concept phase,	4 4 functional
15XPXS-E 16DITS-E Design of the ve dependences and 16ESDP-E	Training course for study programme IS Vehicles within ITS chicle with focus on its use and function in frame of ITS. User requirement analyses. Economic aspects. Process of constructions in a d structure of the designed object. Creation of functional models. Energy management and storages for ground vehicles, energy trans one. Propulsion systems / traditional and alternative ones. Life-cycle analysis.	Z Z,ZK a concept phase, sformations leadin Z,ZK	4 4 functional ng to kinetic 3
15XPXS-E 16DITS-E Design of the ve dependences and 16ESDP-E Advanced vehic	Training course for study programme IS           Vehicles within ITS           ehicle with focus on its use and function in frame of ITS. User requirement analyses. Economic aspects. Process of constructions in a distructure of the designed object. Creation of functional models. Energy management and storages for ground vehicles, energy trans one. Propulsion systems / traditional and alternative ones. Life-cycle analysis.           Electronic systems in modern vehicles           le systems, electromobility, V2I and V2V, autonomous driving. Combustion engine control and electronic control units. Electric propuls on control. Management of hybrid propulsion for attaining its optimal efficiency. Vehicle communication bus (CAN, LIN, FlexRay etc.).	Z Z,ZK a concept phase, sformations leadin Z,ZK sion, its compone	4 4 functional ng to kinetic 3 ents, basic
15XPXS-E 16DITS-E Design of the ve dependences and 16ESDP-E Advanced vehic characteristics a	Training course for study programme IS           Vehicles within ITS           ehicle with focus on its use and function in frame of ITS. User requirement analyses. Economic aspects. Process of constructions in a distructure of the designed object. Creation of functional models. Energy management and storages for ground vehicles, energy trans one. Propulsion systems / traditional and alternative ones. Life-cycle analysis.           Electronic systems in modern vehicles           le systems, electromobility, V2I and V2V, autonomous driving. Combustion engine control and electronic control units. Electric propuland control. Management of hybrid propulsion for attaining its optimal efficiency. Vehicle communication bus (CAN, LIN, FlexRay etc.). comfort electronic vehicle systems. Practical exercises with real and simulated systems.	Z Z,ZK a concept phase, sformations leadin Z,ZK sion, its compone Safety, communi	4 functional ng to kinetic 3 ents, basic cation and
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15XPXS-E 16DITS-E Design of the ve dependences and 16ESDP-E Advanced vehic characteristics a 16KSD-E Quality methods us process design and 16SHMI-E simulation for the s	Training course for study programme IS         Vehicles within ITS         ehicle with focus on its use and function in frame of ITS. User requirement analyses. Economic aspects. Process of constructions in a distructure of the designed object. Creation of functional models. Energy management and storages for ground vehicles, energy trans one. Propulsion systems / traditional and alternative ones. Life-cycle analysis.         Electronic systems in modern vehicles         le systems, electromobility, V2I and V2V, autonomous driving. Combustion engine control and electronic control units. Electric propulate on a distructure of the design. V2I and V2V, autonomous driving. Combustion engine control and electronic control units. Electric propulate on the one of the design. V2I and V2V, autonomous driving. Combustion engine control and electronic control units. Electric propulate one one for the design. V2I and V2V, autonomous driving. Combustion engine control and electronic control units. Electric propulate one one of the design. V2I and V2V, autonomous driving. Combustion engine control and electronic control units. Electric propulate one one of the design. V2I and V2V, autonomous driving. Combustion engine control and electronic control units. Electric propulate one of the design. Nanagement of hybrid propulsion for attaining its optimal efficiency. Vehicle communication bus (CAN, LIN, FlexRay etc.). comfort electronic vehicle systems. Practical exercises with real and simulated systems.         Quality and reliability in area of transportation means and systems         Red for design, manufacturing and operation. Methods QFD, DFM, DFA, DFS. Longtime testing. FMEA method. Operation reliability. M         duality improveme	Z Z,ZK a concept phase, sformations leadin Z,ZK sion, its compone Safety, communi Z,ZK lethods for proces on and improveme Z,ZK for ITS. Simulatic	4 functional ing to kinetic ants, basic cation and 3 ss optimizin ent. Studen 3 on theory wi
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	Master Thesis for study programme IS		16
18XPXS-E	Training course for study programme IS	Z	4
20AIMI-E	Application of ITS in Urban Engineering	Z,ZK	6
The course focuses mainly on the issue of the installation of engineering networks in the area, coordination of engineering activities in the area, organization of the public space, concept			
of public space solutions, design of systems for traffic and transport telematics management, coordination of transport modes - automobil, pedestrian, MHD, cyclo, modes etc. New			
approaches to the development of Smart and green approaches Promoting into Public.			
20BITS-E	Safety and reliability of ITS Systems	KZ	3
The basic concepts of safety and reliability in the job and application. Basic schema and types of diagnostic systems including reliability diagnostics of technical equipment and ITS.			
Investigation of acceptability and reliability prediction, traffic crity and sensitivity analysis. Neural Networks and other optimization algorithms and ETA, FMEA failure analysis. HMI in			
traffic including operator testing on simulator and in real-world situatiation			
20GINS-E	Geographical, information, localization and navigation systems	Z,ZK	6
The subject is specialized in problems of work with applications of geographic information systems with special attention to the specialization in the field of transport and telecommunication.			
It introduces students to geographic data management practices and tools, real world modeling, geographic data storage models, data entry and digitization methods, and a number			
of other GIS related technologies such as problem mapping, webmap, etc.			
20HEI-E	Evaluation and Economics of ITS	KZ	3
-	ect is devoted to the basics of system approach to development of ITS architecture and fundamentals in the field of economic attribute		-
of ITS. Subsequently, the basic principles of system and application creation in the technical field are discussed, defining the penetration of the technical solution into the economy.			
The subject is terminated by a detailed breakdown of case studies.			
20ITSR-E	ITS - R	Z,ZK	3
	s devoted to description of the architecture and interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the communication interface of the system with the ITS-R concept, the concept, the concept and the concept. The concept and the concept and the concept and the concept and the concept. The concept and the concept and the concept. The		-
functional and security features are defined. The principles of ERTMS / ETCS application level 3, UGTMS, CBTC are discussed in detail. Current and future communication technologies			
are described.			
20MZZ-E	Modern techniques of safety control of moving railway vehicles	Z,ZK	3
ERTMS / ETCS concepts, ETCS architecture and interface descriptions, ERTMS system level, infrastructure and mobile part of the system, linking to stationary security systems,			
operating and application modes of the system, infrastructure orientation, interface (DMI), integration of the ETCS mobile part into the driving vehicle, GSM-R functional specification,			
	testing and legislation.	· · · · · · · · · · · · · · · · · · ·	
20PRZP-E	Computer aided railway traffic control	Z,ZK	3
Introduction is devoted to clarifying the reasons and basic principles of automation of the management of railway transport. It explains the structure of railway traffic management,			
including the main	principles applied in the management of railway traffic. The main part is devoted to detailed description of the individual components	of the system, whi	ch must be
	included in the systems for automation of railway traffic control using computer technologies.		
20SYIN-E	System Engineering	Z,ZK	6
	definition in engineering tasks, specification of selected system types against related tools of system analysis and design, refinemer		-
engineering tasks, definition of system strategy, connection to science-based methodological basics of transport, strategic thinking processes, strategic management system, context			
of sustainable development.			
20TSJ-E	Telematic systems and their design	Z,ZK	6
Gradual detaile	d analysis of individual existing telematics systems in modes of transport, such as toll systems, vehicle weighing, fleet management	, traffic manageme	nt, etc.
20TVHD-E	Telematics in Public Transport	Z,ZK	3
Ticketing and information systems; foreinght experiences; vehicle technology; dispatching systems; Information Systems; data structures; clearing; Public Transport preferences; vehicle			
position monitoring; legislative framework; standardization, certification and interoperability.			
20XN1S-E	Master project 1 for study programme IS	Z	5
20XN2S-E	Master project 2 for study programme IS	Z	6
20XN3S-E	Master project 3 for study programme IS	Z	6
20XN4S-E	Master project 4 for study programme IS	Z	10
20XNDS-E	Master Thesis for study programme IS	Z	16
20XPXS-E	Training course for study programme IS	Z	4
21XN1S-E	Master project 1 for study programme IS	Z	5
21XN2S-E	Master project 2 for study programme IS	Z	6
21XN3S-E	Master project 3 for study programme IS	Z	6
21XN4S-E	Master project 4 for study programme IS	Z	10
21XNDS-E	Master Thesis for study programme IS	Z	16
21XPXS-E	Training course for study programme IS	Z	4
22XN1S-E	Master project 1 for study programme IS	Z	5
22XN2S-E	Master project 2 for study programme IS	Z	6
22XN3S-E	Master project 2 for study programme IS	Z	6
			-
22XN4S-E	Master project 4 for study programme IS	Z	10
22XNDS-E	Master Thesis for study programme IS	Z	16
22XPXS-E	Training course for study programme IS	Z	4
23TBSS-E	Technology and Security of Sensor Networks	KZ	2
The course focuses on the safety of data collection in new areas of sensor networks. Principles of sensor networks, sensors of electrical and non-electric quantities, interfaces for			
sensor connection, communication technology for sensor networks, SigFox, LoRa, NB-IoT, IoT technology and SmartCity. Trends in IoT and Smart City			
23XN1S-E	Master project 1 for study programme IS	Z	5
23XN2S-E	Master project 2 for study programme IS	Z	6
23XN3S-E	Master project 3 for study programme IS	Z	6
23XN4S-E	Master project 4 for study programme IS	Z	10
23XNDS-E	Master Thesis for study programme IS	Z	16
23XPXS-E	Training course for study programme IS	Z	4

For updated information see <u>http://bilakniha.cvut.cz/en/FF.html</u>

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