Description of course	
Code of course	**1160-TR000-MSA-0106**
Name of course	**Innovative Means and Infrastructure of Transport**
Version of course	2021/22
A. ***Place of the course in system of studies***	
Level of education	*Second-cycle degree*
Form and mode of studies	*Full-time studies*
Field of studies	*Transport*
Profile of studies	*General academic profile*
Specialization	*Common for the field*
Place of teaching of course	*Warsaw University of Technology, Faculty of Transport, Division of Traffic Control and Transport Infrastructure*
Place of realization of course	*Not applicable*
Coordinator of course	*Prof. dr hab. inż. Krzysztof Zboiński, profesor, Division of Traffic Control and Transport Infrastructure, Faculty of Transport, Warsaw University of Technology*
B. ***General characteristic of the course***	
Group/*Block of courses*	*Common for the field*
Level of course	*Medium*
Type of course	*Mandatory*
Language of course	*English*
Location of the course in the study plan – nominal semester	1
Location of the course in the academic year	*Winter semester*
Preliminary requirements - formal	*No.*
Limit of students	*Lecture: 100 students.*
C. ***Effects of education and manner of teaching***	
Purpose of course	Giving and systematizing knowledge within the scope of innovative vehicles and infrastructure, making main elements of the innovative transport systems as well as their influence on organization of technical systems of rail and road transport.

Effects of education with reference to the learning outcomes for the area and field of study

Effect no.	***Description of the effect***	***Reference to the characteristics of learning outcomes***	***Reference to the learning outcomes in the program***
Assumed learning outcomes in terms of knowledge			
W01	Possesses general knowledge concerning innovative technical solutions of vehicles and infrastructure as well as innovative technical systems of the ground transport	I.P7S_WG.o I.P7S_WK	Tr2A_W05 Tr2A_W11
W02	Possesses detailed knowledge concerning innovative technical solutions in the scope of vehicles and infrastructure and their organization in technical systems of the innovative character	I.P7S_WG.o I.P7S_WK	Tr2A_W05 Tr2A_W11
W03			
Assumed learning outcomes in terms of skills			
U01	–		
U02	–		
U02	–		
Assumed learning outcomes in the field of social competences			
KS01	–	–	–

Form of didactic studies and number of hours	*Lecture*	*Exercise*	*Laboratory*	*Project*	*Other*
On a weekly plan	2	0	0	0	0
Throughout the semester	30	0	0	0	0

Contents of education - separately for each form of didactic studies	*Lecture:* • Means and infrastructure of transport - definitions, classification and consideration within national and European documents. Definition of the railway system with regard to unconventional solutions. • Means and infrastructure of innovative means of ground transport – classification, categories and definitions with regard to futuristic and their level of consideration in national and European strategic projects of transport development. • Innovative means of rail transport – high speed vehicles of rail transport. Innovative elements of construction, differences in relation to vehicles of conventional railways as well as characteristics and technical and exploitation performance. • Innovative means of rail transport – vehicles of magnetic levitation systems. Innovative elements of construction, differences in relation to vehicles of conventional railways as well as characteristics and technical and exploitation performance. • Innovative means of road transport – vehicles of alternative propulsion systems (based on renewable Energy sources) including hydrogen, electric and hybrid ones. Innovative elements of construction, as well as technical and exploitation performance. • Innovative infrastructure of railway transport, co-operating with the innovative vehicles in particular – construction, including non-ballast solutions and innovative elements of traffic control and management, including cabin signaling. • Innovative infrastructure of road transport, co-operating with the innovative vehicles in particular – construction and elements of innovative systems of energy and fuel supply. • Innovative means and infrastructure of ground transport (railway and road one) as elements of the autonomous transport systems. Levels of autonomous systems as well as technical, mental and safety problems. • Innovative systems of ground transport of rarely existing, experimental and futuristic character – Hyperloop transport system including technical, mental and safety problems. Personal Rapid Transit (PRT) systems. • Economic conditioning for innovative transport systems. Influence of innovative solutions of infrastructure and vehicles on ways of traffic and carriage organization. Influence and consequences of innovative transport systems from ecology point of view and on quality of social life, including economy development.
Teaching methods	*Lecture:* Lecture with usage of multimedia presentations in MS PowerPoint, with possibly big numbers of graphical objects and movies.

Methods of verification of effects of education

Effect no.	***Methods of verification***
	Assumed learning outcomes in terms of knowledge
W01	Answer to one or two questions verifying the knowledge and being rated in 2,0-5,0 scale during an exam.
W02	Answer to one or two questions verifying the knowledge and being rated in 2,0-5,0 scale during an exam.
W03	
	Assumed learning outcomes in terms of skills
U01	–
U02	–
U03	–
	Assumed learning outcomes in the field of social competences
KS01	–

Methods of evaluation	*Lecture:*

	Student during an exam answers three exam questions. Each of them is rated in 2,0-5,0 scale. The base for the final mark is a mean value of the marks for each of the three answers.
Exam	*Yes in the written form*
Literature	*Basic literature*: 1) Romaniszyn Z., Wolfram T.: Nowoczesny tabor szynowy. Wyd. Specjalne Instytutu Pojazdów Szynowych, Kraków 1997. 2) Bosh. Napędy hybrydowe, ogniwa paliwowe i paliwa alternatywne. WKŁ. Warszawa 2010. 3) Dębowski A.; Elektryczny napęd trakcyjny. Wydawnictwo Naukowe PWN. Warszawa 2019. 4) Generalna Dyrekcja Dróg Krajowych i Autostrad Oddział w Krakowie: Pojazd autonomiczny na drogach krajowych (pol.). gddkia.gov.pl, 2019-07-11. [dostęp 2020-06-19]. 5) Towpik K.: Koleje Dużych Prędkości. Infrastruktura drogi kolejowej. OW PW. Warszawa 2012. 6) Wojewódzka-Król K., Rolbiecki R.; Infrastruktura transportu. Europa, Polska – teoria i praktyka. PWN. Warszawa 2018. 7) Wojewódzka-Król K., Załoga E.: Transport. Wydawnictwo Naukowe PWN. Warszawa 2016.
Website of the course	No.
D. ***Student's activity***	
Number of ECTS credits	2
Number of hours of student's work to achieve effects of education	60 hours, including work during lectures 30 hours, studying source literature 10 hours, consultations 3 hours, exam attendance 2 hours, and preparations for an exam 15 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,5 ECTS credits (35 hours, including work during lectures 30 hours, consultations 3 hours, exam attendance 2 hours.)
Number of ECTS credits on practical activities on the course	0
E. ***Additional information***	
Notes	*As long as it does not cause changes in the relationship of a given subject with the directional effects in the content of education, changes may be introduced on an ongoing basis, taking into account the latest scientific achievements.*
Date of last edition	2021-08-23