Description of course	
Code of course	**1160-TR000-MSA-0105**
Name of course	**Measurement Systems in Transportation Practice**
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	Main field
Place of teaching of course	Warsaw University of Technology, Faculty of Transport, Division of of Information Technology and Mechatronics in Transport
Place of realization of course	Not applicable
Coordinator of course	PhD Eng. Grzegorz Dobrzynski, Division of of Information Technology and Mechatronics in Transport, Faculty of Transport, Warsaw University of Technology

B. *General characteristic of the course*

Group/*Block of courses*	Specialization courses
Level of course	Intermediate
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	1 semester
Preliminary requirements - formal	-
Limit of students	-

C. *Effects of education and manner of teaching*

Purpose of course	The aim of the course is to acquaint students with the theory and practice of building measurement systems used in transport systems.

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

No. effect	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	Has knowledge of the theory of signals and their basic characteristics in the time and frequency domains.	I.P7S_WG.o	Tr2A_W07
W02	Has detailed knowledge of digital-to-analog processing.	I.P7S_WG.o I.P7S_WK	Tr2A_W07 Tr2A_W11
W03	Has knowledge of the selection of sensors and measuring transducers, the correct conditions of their work and calibration.	I.P7S_WG.o I.P7S_WK	Tr2A_W07 Tr2A_W11
Assumed learning outcomes in terms of skills			
U01	Is able to synthesize the measurement path with the use of computer techniques.	I.P7S_UW.o. III.P7S_UW.o	Tr2A_U06
U02	Can estimate selected characteristics and interpret the results.	I.P7S_UW.o. III.P7S_UW.o	Tr2A_U06
U03	Can measure shape.	I.P7S_UW.o. III.P7S_UW.o	Tr2A_U06
U04	Can cooperate with other people during team work and take a lead a team.	I.P7S_UO	Tr2A_U20
Assumed learning outcomes in the field of social competences			
KS01	Can think and act in a creative and enterprising way.	I.P7S_KO	Tr2A_K04

Form of didactic studies and number of hours	Lecture	Exercise	Laboratory	Project	Other
On a weekly plan	1	0	1	0	0
Throughout the semester	15	0	15	0	0

Contents of education - separately for each form of didactic studies	Lecture: Division and classification of physical signals. Overview of selected sensors used in transport technology - the physical basis of their operation, structure, properties, basic static and dynamic characteristics. Examples of measuring systems with serial and parallel interfaces, wireless measuring systems. Selected aspects of signal processing, analog-to-digital conversion, sampling theorem. 3D measurement techniques. Digital representation of measurement results and the possibility of using it to control autonomous vehicles. Laboratories: Selected aspects in the field of construction, operation, functionality of measurement tracks with the use of types of sensors used in transport technology. Determination and interpretation of selected signal characteristics. 3D measurement with non-contact methods.
Teaching methods	Lecture: Lecture enriched with a multimedia presentation and sketches made during the presentation, discussion. Laboratories: Laboratory methods, measurements, instruction, discussion.

Methods of verification of effects of education

No. effect	Methods of verification
Assumed learning outcomes in terms of knowledge	
W01	Colloquium from the lecture, 2 open questions, correct answer required at 50%.
W02	Colloquium from the lecture, 2 open questions, correct answer required at 50%.
W03	Colloquium from the lecture, 2 open questions, correct answer required at 50%.
Assumed learning outcomes in terms of skills	
U01	Correct execution of exercises, preparation of reports.
U02	Correct execution of exercises, preparation of reports.
U03	Correct execution of exercises, preparation of reports.
U04	Correct execution of exercises, preparation of reports.
Assumed learning outcomes in the field of social competences	
KS01	Correct execution of exercises, preparation of reports.

Methods of evaluation	Lecture: The condition for passing the lectures is to obtain positive grades from both tests, and the final grade for the lectures is issued on the basis of the arithmetic mean of the grades from these tests. Laboratories: The condition for passing the laboratory exercises is to obtain a positive grade from all reports and tests of the companionway type, where the final grade for laboratory exercises is issued on the basis of the arithmetic mean of the unit grades. Integrated assessment: The condition for passing the course is to obtain positive grades for passing the lecture part and for passing the laboratories, while the final grade for the course is issued on the basis of calculating the weighted average of the grades for the lecture part with a weight of 0.4 and a laboratory weight of 0.6.
Exam	No
Literature	*Basic literature*: Basic literature: 1. John P. Bentley, Principles of Measurement Systems, ISBN 0 130 43028 5, 2005; web: http://research.iaun.ac.ir/pd/imanianold/pdfs/HomeWork_8460.pdf *Supplementary literature*:

	2. Robert Czabanowski, SENSORY I SYSTEMY POMIAROWE, Dolnośląska Biblioteka Cyfrowa, Politechnika Wrocławska, 2010r., http://www.dbc.wroc.pl/Content/7205/czabanowski_sensory.pdf; 3. Krzysztof Karbowski, Podstawy rekonstrukcji maszyn i innych obiektów w procesach wytwarzania, Politechnika Krakowska, 2008r. (via www)
Website of the course	www.epw.pw.edu.pl
D. *Student's activity*	
Number of ECTS credits	3
Number of hours of student's work to achieve effects of education	88 hours, including: work on lectures 15 hours, work on laboratory exercises 15 hours, preparation for the lecture test 11 hours, preparation for laboratory classes 10 hours, preparation of reports 25 hours, consultations 3 hours . (including consultations in the field of the laboratory 2 hours), studying the literature of the subject 9 hours
Number of ECTS credits on the course with direct participation of academic teacher	1.5 points ECTS (33 hours, including: work on lectures 15 hours, work on laboratory exercises 15 hours, consultations 3 hours)
Number of ECTS credits on practical activities on the course	2.0 points ECTS (52 hours, including: work on laboratory exercises 15 hours, preparation for laboratory classes 10 hours, preparation of reports 25 hours, consultation in the laboratory 2 hours)
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.*
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