

Description of course			
Code of course	1160-TR000-MSA-0104		
Name of course	Reliability and Safety Theory		
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	Subject common to the field of study Transport		
Place of teaching of course	Warsaw University of Technology, Faculty of Transport, Division of Vehicle Maintenance and Operation		
Place of realization of course	Not applicable		
Coordinator of course	Andrzej WOLFF, Ph.D., D.Sc., Division of Vehicle Maintenance and Operation, Faculty of Transport, Warsaw University of Technology		
B. General characteristic of the course			
Group/Block of courses	Field courses (Transport)		
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	winter semester		
Preliminary requirements - formal	No initial requirements		
Limit of students	Lecture: 100 persons; Computer classes: 15 persons		
C. Effects of education and manner of teaching			
Purpose of course	Ability to evaluate the operational reliability and safety of technical 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	The student correctly interprets basic concepts related to the reliability and safety of the technical system.	I.P7S_WG.o III.P7S_WG	Tr2A_W08
W02	The student knows methods of improving the reliability of objects and knows and understands the basic processes taking place in the life cycle of devices, technical objects and systems.	I.P7S_WG.o III.P7S_WG I.P7S_WK	Tr2A_W08 Tr2A_W10 Tr2A_W11
W03	The student knows probabilistic models used to describe the reliability and safety of systems.	I.P7S_WG.o III.P7S_WG	Tr2A_W08 Tr2A_W10
W04	The student understands the relationship between reliability and safety.	I.P7S_WG.o III.P7S_WG	Tr2A_W08
Assumed learning outcomes in terms of skills			
U01	The student is able to analyze and synthesize systems of various reliability networks.	I.P7S_UW.o III.P7S_UW.o	Tr2A_U09
U02	The student is able to estimate functional and numerical indicators of system reliability and safety based on results of maintainability tests.	I.P7S_UW.o III.P7S_UW.o	Tr2A_U07 Tr2A_U09
U03	The student is able to analyze multi-state maintenance processes using appropriate measures.	I.P7S_UW.o III.P7S_UW.o	Tr2A_U07 Tr2A_U09
Assumed learning outcomes in the field of social competences			
KS01	–	–	–

<i>Form of didactic studies and number of hours</i>	<i>Lecture</i>	<i>Exercise</i>	<i>Laboratory</i>	<i>Project</i>	<i>Computer classes</i>
<i>On a weekly plan</i>	1	0	0	0	1
<i>Throughout the semester</i>	15	0	0	0	15
<i>Contents of education - separately for each form of didactic studies</i>	<p><i>Lecture:</i> Introduction to reliability and safety of technical systems. Basic terms and definitions. Reliability models of non repairable objects for various theoretical probability distributions of operation time. Designing principles of reliable systems using unreliable components. Reliability networks. Reliability models of repairable objects. Reliability testing methods and their programming. Criteria and methods for ensuring the required reliability of the objects. Principles of building secure systems. The relationship between reliability and safety. Technical, organizational and economic aspects of ensuring the reliability and safety of systems.</p> <p><i>Computer classes:</i> Determination of functional and numerical characteristics of simple and complex objects. Analysis and synthesis of systems of various reliability networks. Estimation of indicators of reliability based on results of maintainability tests.</p>				
<i>Teaching methods</i>	<p><i>Lecture:</i> Lectures in the form of electronic presentations containing necessary descriptions, mathematical relationships and graphs. During the lecture activity of students is stimulated (short questions and answers). Analytical solutions of typical tasks are also presented. Analogous examples should be solved during the written test organized at the last lecture.</p> <p><i>Computer classes:</i> Individual student work in form of solving various mathematical tasks on a personal computer using an available worksheet or specialized software.</p>				
Methods of verification of effects of education					
<i>No. effect</i>	<i>Methods of verification</i>				
Assumed learning outcomes in terms of knowledge					
W01	<i>Lecture:</i> written test (approximately dozen closed questions), or 2 tasks to be solved. An execution level of at least 51% is required.				
W02	<i>Lecture:</i> written test (approximately dozen closed questions), or 2 tasks to be solved. An execution level of at least 51% is required.				
W03	<i>Lecture:</i> written test (approximately dozen closed questions), or 2 tasks to be solved. An execution level of at least 51% is required. <i>Computer classes:</i> self-solution of 2-3 tasks on a personal computer using an available Excel worksheet. In both cases an execution level of at least 51% is required.				
W04	<i>Lecture:</i> written test (approximately dozen closed questions), or 2 tasks to be solved. An execution level of at least 51% is required.				
Assumed learning outcomes in terms of skills					
U01	<i>Lecture:</i> written test (approximately dozen closed questions), or 2 tasks to be solved. An execution level of at least 51% is required.				
U02	<i>Computer classes:</i> self-solution of 2-3 tasks on a personal computer using an available Excel worksheet. An execution level of at least 51% is required.				
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Assumed learning outcomes in the field of social competences					
KS01	–				
<i>Methods of evaluation</i>	<p><i>Lecture:</i> Written test (approximately dozen closed questions), or 2 tasks to be solved.</p> <p><i>Computer classes:</i> Self-solution of 2-3 tasks on a personal computer using an available Excel worksheet. In both cases an execution level of at least 51% is required.</p> <p><i>Integrated assessment:</i> The final grade for the entire course is the arithmetic mean of the grades obtained</p>				

	during the lecture and computer classes.
<i>Exam</i>	<i>No</i>
<i>Literature</i>	<p><i>Basic literature:</i></p> <p>1) Birolini A.: <i>Reliability Engineering: Theory and Practice</i>, Springer, 2014; 2) Dhillon, B. S.: <i>Design Reliability. Fundamentals and Applications</i>, CRC Press, London, New York 1999. 3) Nakagawa T.: <i>Maintenance Theory of Reliability</i>, Springer, 2005.</p> <p><i>Supplementary literature:</i></p> <p>1) Chin-Diew Lai, Min Xie: <i>Stochastic Ageing and Dependence for Reliability</i>, Springer, 2006; 2) Kuo Way, Zuo Ming J.: <i>Optimal Reliability Modeling: Principles and Applications</i>, Wiley & Sons, New York, 2003.</p>
<i>Website of the course</i>	<i>No</i>
D. Student's activity	
<i>Number of ECTS credits</i>	3
<i>Number of hours of student's work to achieve effects of education</i>	88 hours, including: lecture work 15 hours, computer classes work 15 hours, preparation for computer classes 20 hours, preparation of computer classes reports 13 hours, study of literature 12 hours, consultations 3 hours. (including 2 hours concerning computer classes), preparation for the test at the last lecture: 10 hours.
<i>Number of ECTS credits on the course with direct participation of academic teacher</i>	1,5 ECTS points (33 hours, including lectures 15 hours, computer classes 15 hours, consultations 3 hours).
<i>Number of ECTS credits on practical activities on the course</i>	2,0 ECTS points (50 hours, including computer classes: 15 hours, preparation for computer classes 20 hours, preparation of computer reports 13 hours, computer classes consultations 2 hours).
E. Additional information	
<i>Notes</i>	<i>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.</i>
<i>Date of last edition</i>	2021-08-26