



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Reliability and safety of technical objects

### Course

Field of study

Aviation

Area of study (specialization)

Safety of air transport

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

2/4

Profile of study

general academic

Course offered in

Polish

Requirements

compulsory

### Number of hours

Lecture

30

Laboratory classes

0

Other (e.g. online)

0

Tutorials

30

Projects/seminars

0

### Number of credit points

4

### Lecturers

Responsible for the course/lecturer:

dr hab. inż. Adrian Gill

Responsible for the course/lecturer:

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### Prerequisites

Knowledge: knows the construction of basic types of technical objects and knows the general principles of their operation; has basic knowledge of probability and mathematical statistics

Skills: can use basic models in the field of probability and mathematical statistics.

Social competences: understands that the further from the phase of constructing technical objects their high unreliability is noticed, the more expensive it is; is aware that the costs of repairing technical objects usually account for a small part of the losses caused by their damage; knows how to manage the time available to perform the tasks indicated for the implementation.



### Course objective

Learning about elementary and advanced methods, processes, procedures and models relating to problems of reliability and safety of systems and learning the skills to apply them.

### Course-related learning outcomes

#### Knowledge

has ordered and theoretically founded general knowledge in the field of key technical issues and detailed knowledge in the field of selected reliability issues of technical objects

has ordered, theoretically founded general knowledge in the field of technology and various means of air transport, about the life cycle of means of transport, both hardware and software, and in particular about the key processes taking place in them

has ordered and theoretically founded general knowledge in the field of key technical issues and detailed knowledge of selected issues related to air transport, knows the basic techniques, methods and tools used in the process of solving tasks related to air transport, mainly of an engineering nature

#### Skills

the student can use theoretical probability distributions; is able to analyze and interpret statistical data; is able to use the methods and tools of mathematical statistics in engineering practice.

can use the language of mathematics (differential and integral calculus) to describe simple engineering problems

can determine the properties of technical objects in the form of reliability characteristics

#### Social competences

understands that in technology, knowledge and skills very quickly become obsolete

is aware of the importance of knowledge in solving engineering problems, knows examples and understands the causes of malfunctioning engineering projects that have led to serious financial and social losses, or to a serious loss of health and even life

correctly identifies and resolves dilemmas related to the profession of aerospace engineer

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

written examination

### Programme content

Formal and substantive introduction to the subject (program, hourly structure, literature, method of completion, introduction to the reliability of technical facilities). Technical objects as subjects of reliability assessments. Renewed and not renewed technical objects; object failure. Reliability tests of technical objects. Life models of non-renewed and renewed objects. Reliability of non-renewable objects: probabilistic and statistical reliability characteristics. Selected elements of structural reliability. Classification of reliability structures; simple and complex structures. Fault tree analysis. Reliability



control of systems with simple structures. Reliable model of operation of technical objects with non-zero renovation time. Markov multi-state models of technical objects operation. Function and coefficient of availability. Estimating the time of the object's stay in states of the exponential type. The concept of ensuring the safety of technical objects. Methods of risk analysis at the stage of designing technical objects. Exercises in applying methods, processes, procedures and models related to the reliability and safety of technical objects.

### Teaching methods

Lecture: with the use of multimedia presentations and computer applications.

Exercises: electronic presentations in the stages of formulating problems to be solved and presenting the final results, solving fragments of problems on the board by the teacher and / or students.

### Bibliography

Basic

1. Inżynieria niezawodności, Por. pod red. J. Migdalskiego, Wyd. ATR Bydgoszcz i Ośr. Badań Jakości Wyr. "ZETOM", Warszawa, 1992
2. Kadziński A., Niezawodność obiektów technicznych. E-skrypt Politechniki Poznańskiej, Poznań, 2012.
3. Karpiński J., Korczak E., Metody oceny niezawodności dwustanowych systemów technicznych. Wyd. Omnitech Press, Instytut Badań Systemowych, Warszawa, 1990
4. Augustyn, E., Kadziński, A., Gill, A. Safety systems components in air task domain of Tactical Aircraft Operating System. Transportation Research Procedia, Elsevier B.V. 2019. Vol. 40. P. 1238–43. <https://doi.org/10.1016/j.trpro.2019.07.172>.
6. Żółtowski J., Wybrane zagadnienia z podstaw konstrukcji i niezawodności maszyn. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2004.
7. Lewitowicz, J. Podstawy eksploatacji statków powietrznych. Wydawnictwo Instytutu Technicznego Wojsk Lotniczych, Warszawa. 2007.
8. Szymanek A., Bezpieczeństwo i ryzyko w technice. Wyd. Politechniki Radomskiej, Radom 2006.

Additional

1. Bobrowski D., Modele i metody matematyczne teorii niezawodności w przykładach i zadaniach, WNT, Warszawa, 1985
5. Niezawodność i eksploatacja systemów. Pod redakcją Wojciecha Zamojskiego. Wyd. Politechniki Wrocławskiej, Wrocław 1981
6. Radkowski S., Podstawy bezpiecznej techniki. Oficyna Wyd. Politechniki Warszawskiej, Warszawa 2003



7. Słowiński B., Podstawy badań i oceny niezawodności obiektów technicznych. Wyd. Uczelniane Wyższej Szkoły Inżynierskiej w Koszalinie, Koszalin 1992

8. Kadziński, A. Studium wybranych aspektów niezawodności systemów oraz obiektów pojazdów szynowych [Study on selected dependability aspects of systems and rail vehicles objects]. Wydawnictwo Politechniki Poznańskiej, Poznań. 2013.

9. Gill, A. Warstwowe modele systemów bezpieczeństwa do zastosowań w transporcie szynowym [Layered models of safety systems for rail transport applications]. Wydawnictwo Politechniki Poznańskiej, Poznań. 2018.

### Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,0
Classes requiring direct contact with the teacher	60	2,5
Student's own work (literature studies, preparation for classes, preparation for tests,) <sup>1</sup>	40	1,5

<sup>1</sup> delete or add other activities as appropriate