# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Reliability of technical objects [S1Trans1>NOT]

## Course

Field of study
Transport

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

## Number of hours

Lecture
15

Laboratory classes
0

Other
0

Tutorials
30

Projects/seminars
0

## Number of credit points

3,00

## Coordinators

dr hab. inż. Adrian Gill
adrian.gill@put.poznan.pl

## Lecturers

## Prerequisites

Student knows structures of basic types of technical objects and general rules of operation of the same. Student has basic skills in probability calculus and mathematical statistics. Student can use basic models relating to skills in probability calculus and mathematical statistics. Student has fluent skills in computer office software. Student understands that the further from the design stage of technical objects the high unreliability is detected the greater the costs. Student realizes that costs of repairs of technical objects usually constitute a small part of losses caused by damage of the same. Student can manage his/her own time dedicated to performance of indicated tasks.

## Course objective

Acquisition of knowledge skills relating to elementary methods, procedures, models and characteristics connected with reliability of technical objects.

## Course-related learning outcomes

Knowledge:
The student has an ordered, theoretically founded general knowledge of technology, transport systems and various means of transport

The student has ordered and theoretically founded general knowledge in the field of key issues of technology and detailed knowledge in the field of selected issues in this discipline of transport engineering
The student has knowledge of important development trends and the most important technical achievements and of other related scientific disciplines, in particular transport engineering

Skills:
The student is able to take into account in the process of formulating and solving tasks in the field of transport engineering also non-transport aspects, in particular social, legal and economic issues
The student is able to assess the computational complexity of algorithms and transport problems
Student is able to make a critical analysis of the functioning of transport systems and other technical solutions and to evaluate these solutions, including: is able to effectively participate in the technical inspection and assess the transport task from the point of view of non-functional requirements, has the ability to systematically conduct functional tests

Social competences:
The student can think and act in an entrepreneurial way, incl. finding commercial applications for the created system, taking into account not only business benefits, but also social benefits of the conducted activity
The student is aware of the social role of a technical university graduate, in particular, he/she understands the need to formulate and transfer to the society, in an appropriate style, information and opinions on engineering activities, technological achievements, as well as the achievements and traditions of the transport engineer profession
The student correctly identifies and solves dilemmas related to the profession of a transport engineer

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired during the lecture is checked on the basis of one 45-minute test taking place during the last lecture.
The content of the exercises is passed on the basis of the results of the written test during the last practical classes.

## Programme content

The programme content covers the fundamental reliability issues of technical objects (i.e. reliability models and characteristics of non-renewed and renewed objects).

## Course topics

Introduction to the topic of the course. The curriculum, hours, literature and method to course passing. Technical objects as objects of reliability tests. Non-renewable and renewable objects. Failure of an technical object. Reliability tests of technical objects. Models of life of non-renewable and renewable objects – probabilistic reliability characteristics. Reliability of non-renewable objects – statistical reliability characteristics. Selected elements of structural reliability. Classification of reliability structures – simple and complex structures. Simple structures: serial, parallel, serial-parallel and parallel-serial structures. Fault tree. Control of reliability of systems with simple structures. A reliability model of operation of technical objects with non-zero renewal time. A bistate model of operation of technical objects. Markov processes. The availibility and unavailibility function. A coefficient of availibility and unavailibility. The duration of states of exponential type. Markov multistate models of operation of technical objects. A repertory of reliability characteristics of technical non-renewable and renewable objects.
Exercises. Discrete and continuous random variables. Basic distributions of discrete and continuous random variables. Verification of hypotheses about the form of distribution of selected random variables. Determination of mutual dependencies between reliability characteristics of non-renewable technical objects. Determining the values of point and functional reliability characteristics of non-renewable components of technical objects in probabilistic and statistical terms. Determining measures of availibility of components of renewable technical objects. Construction and solving of multi-state Markov models of technical objects. Determining the reliability of components and systems of technical objects in terms of structural reliability.

## Teaching methods

Lecture: credit based on written tests.
Practical classes: credit based on reports prepared and a written test.

## Bibliography

Basic:
1. Inżynieria niezawodności, Por. pod red. J. Migdalskiego, Wyd. ATR Bydgoszcz i Ośr. Badań Jakości Wyr. "ZETOM", Warszawa, 1992.
2. Karpiński J., Korczak E., Metody oceny niezawodności dwustanowych systemów technicznych. Wyd. Omnitech Press, Instytut Badań Systemowych, Warszawa, 1990.
3. Migdalski J., Podstawy strukturalnej teorii niezawodności. Skrypt Politechniki Świętokrzyskiej, Kielce, 1978.
4. Poradnik niezawodności. Podstawy matematyczne. Wyd. Przemysłu Maszynowego „WEMA”, Warszawa, 1982.
5. Żółtowski J., Wybrane zagadnienia z podstaw konstrukcji i niezawodności maszyn. Oficyna Wyd. Politechniki Warszawskiej, Warszawa, 2004.
Additional:
1. Bobrowski D., Modele i metody matematyczne teorii niezawodności w przykładach i zadaniach, WNT, Warszawa, 1985.
2. Jaźwiński J., Ważyńska-Fiok K., Niezawodność systemów technicznych. Wyd. Naukowe PWN, Warszawa, 1990.
3. Kadziński A., Niezawodność pojazdów szynowych. Ćwiczenia laboratoryjne, Wyd. Politechniki Poznańskiej, Poznań, 1992.
4. Niezawodność autobusów. Pod redakcją Anieli Gołąbek, Wyd. Politechniki Wrocławskiej, Wrocław, 1993.
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. Żółtowski J., Podstawy niezawodności maszyn. Wyd. Politechniki Warszawskiej, Warszawa, 1985.

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 70 | 3,00 |
| Classes requiring direct contact with the teacher | 45 | 2,00 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 25 | 1,00 |