COURSE DESCRIPTION CARD - SYLLABUS

Course name
Systems reliability [S1Lot2-BSP>NS]

Course

Field of study
Aviation

Year/Semester
3/6

Area of study (specialization)
Unmanned Aerial Vehicles

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
0

Other
0

Tutorials
15

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Understanding of system concepts. Basic knowledge of probability theory and mathematical statistics. Basic understanding of the reliability of technical objects. Ability to apply fundamental probability and statistical models. Familiarity with basic reliability models of technical objects. Awareness of the necessity to introduce restrictions in social, industrial, and transport systems to improve their functionality.

Course objective

To learn elementary and advanced methods, processes, procedures, and models related to system reliability and acquire skills for their application.

Course-related learning outcomes

Knowledge:
Advanced knowledge of material strength, elasticity and plasticity theories, stress hypotheses, calculation methods for beams, membranes, shafts, joints, and other structural elements.
Understanding of material strength testing methods, deformation and stress analysis in structures.
Knowledge of the main fields of technical mechanics: statics, kinematics, and dynamics of material points and rigid bodies.

Detailed knowledge of aircraft propulsion systems, their component design, life cycles, and technical descriptions.

Skills:
Ability to gather and interpret information from various sources (literature, databases in Polish and English).
Proficiency in using information and communication technologies at different stages of aviation projects.
Capability to apply analytical, simulation, and experimental methods to solve civil aviation problems.
Social Competencies:
Awareness of the importance of knowledge in solving engineering problems and understanding the consequences of defective engineering projects, including financial, social, and safety-related risks.
Understanding the social role of a technical university graduate, particularly the need to communicate engineering-related information and technical achievements to the public.

Social competences:
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Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures: Written test.
Exercises: Written assessment.
Project Work: Evaluation of reports based on exercises.

Programme content

Introduction to the Course - Program, schedule, literature, assessment methods.
Reliability Analysis of Systems - Simple and complex reliability structures.
Fault Tree Analysis (FTA) - Application in reliability assessment.
Operational Reliability Models - Systems with non-zero renewal time.
Multi-State Markov Models - System performance analysis.
Failure Prediction - Assessment of aging-related failures.
Reliability Management (RCM - Reliability-Centered Maintenance) - System maintenance strategies.
Exercises - Practical application of learned methods and models.

Course topics

1. Formal and substantive introduction to the course. Program, schedule, literature, and assessment methods.
2. Reliability analysis of systems with simple and complex reliability structures.
3. Fault Tree Analysis (FTA) and its application in system reliability.
4. Reliability-based operational model for technical objects with non-zero renewal time.
5. Multi-state Markov models for system operation.
6. Failure prediction of system components during their aging failure period.
7. Fundamentals of system reliability management using RCM (Reliability-Centered Maintenance).
Exercises:
Reinforcement of learned methods, processes, procedures, and models through board exercises

Teaching methods

Lecture: Structured presentation of information, either as an introductory or specialized course.
Exercise-Based Learning: Practical application of knowledge through problem-solving and skill training.

Bibliography

Basic:
Migdalski J. (ed.), Reliability Engineering, ATR Bydgoszcz & ZETOM Quality Research Center, Warsaw, 1992.
Kadziński A., Reliability of Technical Objects, Poznan University of Technology, e-script, Poznań, 2019 (unpublished).

Kadziński A., Study on Selected Aspects of System and Railway Vehicle Reliability, Series: Dissertations, No. 511, Poznan University of Technology, Poznań, 2013.
Karpiński J., Korczak E., Methods for Evaluating the Reliability of Binary Technical Systems, Omnitech Press, Institute of Systems Research, Warsaw, 1990.

Additional:
Gill A., Layered Safety System Models for Railway Transport Applications, Poznan University of Technology Press, Poznań, 2018.
Gucma L., Guidelines for Maritime Risk Management, Maritime Academy Publishing, Szczecin, 2009.
Jamroz K., Risk Management Methodology in Road Engineering, Gdańsk University of Technology Press, Gdańsk, 2011.
Kaczmarek T.T., Risk and Risk Management: An Interdisciplinary Approach, Difin Publishing, Warsaw, 2006.
Klich E., Flight Safety, Scientific Publishing of the Institute of Exploitation Technology - PIB, Radom, 2011.
Markowski A.S. (ed.), Preventing Industrial Losses, Part III: Process Safety Management, Łódź University of Technology Press, Łódź, 2000.
Migdalski J., Fundamentals of Structural Reliability Theory, Kielce University of Technology, Kielce, 1978.
Reliability Handbook: Mathematical Fundamentals, WEMA Machine Industry Publishing, Warsaw, 1982.

Breakdown of average student's workload

	Hours	ECTS
Total workload	55	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	25	1,00