



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Reliability and Safety of Engineering Systems

### Course

Field of study

Environmental Engineering Second-cycle Studies

Area of study (specialization)

Heating, Air Conditioning, and Air Protection

Level of study

Second-cycle studies

Form of study

part-time

Year/Semester

1/1

Profile of study

general academic

Course offered in

polish

Requirements

compulsory

### Number of hours

Lecture

10

Laboratory classes

Other (e.g. online)

Tutorials

Projects/seminars

### Number of credit points

1

### Lecturers

Responsible for the course/lecturer:

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Energy

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Responsible for the course/lecturer:

### Prerequisites

1.Knowledge: Mathematical logic, combinatorics and probability theory, random variables, probability distributions of typical random variables!

2.Skills :Identification of random variables, probability calculation of random events, calculations of expected values of discrete and continuous random variables

3.Social competencies:

Consciousness of necessity of permanent updating extending of skills and knowledge



## Course objective

To transfer basic knowledge about relationship between designing rules and reliability of technical systems. To present methods of reliability assessment of environmental engineering systems and elements. To provide knowledge about identify of hazard related to incorrect operation of technical systems

## Course-related learning outcomes

### Knowledge

1. Student knows and understand definitions of basic reliability parameters of technical systems and their applications (achieved during lectures) - [KIS2\_W05; KIS2\_W08; KIS2\_W09]
2. Student has systematic knowledge about reliability structures of technical systems and about properties of these structures (achieved during lectures) - [KIS2\_W05; KIS2\_W08; KIS2\_W09]
3. Student knows basic methods for reliability analysis of technical systems such as : Event Tree Analysis, and Fault Tree Analysis (achieved during lectures) - [KIS2\_W05; KIS2\_W08; KIS2\_W09]
4. Student understands the concept of ?risk? in safety engineering and knows basic rules of risk estimation in engineering (achieved during lectures) - [KIS2\_W05; KIS2\_W08; KIS2\_W09]

### Skills

1. Student is able to recognize reliability structure of simple technical system and to estimate value of its reliability (achieved during lectures) - [KIS2\_U09;KIS2\_U18]
2. Student can calculate reliability parameters of typical engineering structures (achieved during lectures) - [KIS2\_U09;KIS2\_U18]
3. Student is able to apply ?Event Tree Analysis? and ?Fault Tree Analysis? for risk calculations of technical systems (achieved during lectures) - [KIS2\_U09;KIS2\_U18]
4. Student can calculate risk of technical system operation and is able to show method of the risk reduction (achieved during lectures) - [KIS2\_U09;KIS2\_U18]

### Social competences

1. Student understands necessity of collective work in order to solve problems of reliability and safety in environmental engineering (achieved during lectures) - [KIS2\_K01; KIS02\_K02; KIS2\_K03]
2. Student is aware of necessity of permanent development of his professional skills and competence (achieved during lectures) - [KIS2\_K01; KIS02\_K02; KIS2\_K03]
3. Student is able to inform the society about reliability and safety problems of contemporary environmental engineering systems (achieved during lectures) - [KIS2\_K01; KIS02\_K02; KIS2\_K03]

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:



Written final test (3 questions to answer and one problem to solve),

Permanent evaluation at lectures (rewarding students for activity).

To pass the final test there is necessary to obtain at least 50% of the maximum points (max=20 points).

Grading system:

0-9 points = 2,0 (failed)

10-12 points = 3,0 (sufficient)

13-14 points = 3,5 (sufficient plus)

15-16 points = 4,0 (good)

17-18 points = 4,5 (good plus)

19-20 points = 5,0 (very good)

### Programme content

Foundations of reliability analysis. Reliability investigation rules. Reliability factors ? their selection for environmental engineering systems operation assessment. Reliability of technical systems. Statistics methods in technical systems failure analysis. Failure analysis of technical systems in design and operation requirements context. Criteria of technical systems reliability estimation. Alternative solutions in environmental engineering from reliability point of view. Definition of risk and safety, risk assessment and safety estimation, risk and safety management, human factor in risk. Basic methods for reliability analysis of technical systems. ?Event Tree Analysis? and ?Fault Tree Analysis?.

### Teaching methods

classical lecture with elements of conversation and Power Point presentation.

### Bibliography

Basic

1. Bobrowski D.: Elementy teorii prawdopodobieństwa. Wyd. PP, Wydanie III rozszerzone, Poznań 1976
2. J. Bucior, Podstawy teorii i inżynierii niezawodności. Oficyna Wydawnicza Politechniki Rzeszowskiej, Rzeszów 2004
3. J. R. Rak, B. Tchórzewska-Cieślak, Metody analizy i oceny ryzyka w systemie zaopatrzenia w wodę. Oficyna Wydawnicza Politechniki Rzeszowskiej, Rzeszów 2005
4. B. Tchórzewska-Cieślak, Niezawodność i bezpieczeństwo systemów komunalnych (na przykładzie systemu zaopatrzenia w wodę). Oficyna Wydawnicza Politechniki Rzeszowskiej, Rzeszów 2008



5. Woliński S., Wróbel K.: Niezawodność konstrukcji budowlanych. Oficyna Wydawnicza Politechniki Rzeszowskiej, Rzeszów 2001

Additional

### Breakdown of average student's workload

	Hours	ECTS
Total workload	25	1,0
Classes requiring direct contact with the teacher	10	0,5
Student's own work (literature studies, solving problems - homework, preparation for final test) <sup>1</sup>	15	0,5

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