



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Reliability and Safety of Water Supply Systems

### Course

Field of study

Environmental Engineering Second-cycle Studies

Area of study (specialization)

Water Supply, Water and Soil 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

Other (e.g. online)

Tutorials

Laboratory classes

8

Projects/seminars

### Number of credit points

2

### Lecturers

Responsible for the course/lecturer:

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Energy

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### Prerequisites

1.Knowledge: Design, construction and operation of water supply systems. 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 the theory of reliability and safety of water supply systems.

### Course-related learning outcomes

#### Knowledge

1. Student knows and understand definitions of basic reliability parameters of technical systems and their applications.
2. Student has systematic knowledge about reliability structures of technical systems and about properties of these structures.
3. Student knows basic methods for reliability analysis of technical systems such as Event Tree Analysis and Fault Tree Analysis
4. Student understands the concept of risk in safety engineering and knows basic rules of risk estimation in engineering.
5. Student knows the concept and legal basis for the development of Water Safety Plans for water supply systems.
6. Student understands the toxicological aspect in the risk analysis performed for water supply systems, including the concept of representativeness of the results of analyzes in relation to the statistical reference.
7. Student knows the concept of audit and the basic tools for auditing water supply systems in the area of reliability and safety.

#### Skills

1. Student is able to recognize reliability structure of simple technical system and to estimate value of its reliability.
2. Student can calculate reliability parameters of typical engineering structures.
3. Student is able to apply Event Tree Analysis and Fault Tree Analysis for risk calculations of technical systems.
4. Student can calculate risk of technical system operation and is able to show method of the risk reduction.



### Social competences

1. Student understands necessity of collective work in order to solve problems of reliability and safety in environmental engineering.
2. Student is aware of necessity of permanent development of his professional skills and competence.
3. Student is able to inform the society about reliability and safety problems of contemporary environmental engineering systems

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Written final test. 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.

### 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, FMEA method. The legal basis for the application of risk analysis in water supply systems. Fundamentals of toxicology in risk assessment. Water quality monitoring tools and statistical process control. Water Safety Plans in water supply systems. Auditing of water supply systems in the area of reliability and safety. Quality cost accounting.

### Teaching methods

Lecture:

Classical lecture with elements of conversation and Power Point presentation.

Tutorials:

Classes conducted in the form of workshops. Students are divided into exercise groups. Each group receives an individual characteristics of the selected water supply system, and then performs a risk analysis for the system elements indicated by the operator. The effects of their work are presented by each subgroup in the form of a multimedia presentation presented during the classes. The tutor



assesses: the substantive content of the study (60%), the independence of the work of the subgroup (20%), transparency, the aesthetic aspect and the way of presenting the results of the work (20%).

## Bibliography

### Basic

1. Bobrowski D.: Elementy teorii prawdopodobieństwa. Wyd. PP, Wydanie III rozszerzone, Poznań 1976
2. Wieczysty A., Niezawodność systemów wodociągowych i kanalizacyjnych, Kraków 1990
3. Bucior J. , Podstawy teorii i inżynierii niezawodności. Oficyna Wydawnicza Politechniki Rzeszowskiej, Rzeszów 2004
4. Rak J.R., Tchórzewska-Cieślak B., Metody analizy i oceny ryzyka w systemie zaopatrzenia w wodę. Oficyna Wydawnicza Politechniki Rzeszowskiej, Rzeszów 2005
5. Tchórzewska-Cieślak B., Niezawodność i bezpieczeństwo systemów komunalnych (na przykładzie systemu zaopatrzenia w wodę). Oficyna Wydawnicza Politechniki Rzeszowskiej, Rzeszów 2008
6. Water Safety Plan Manual Step-by-step risk management for drinking-water suppliers, WHO, IWA, 2012
7. A practical guide to Auditing water safety plans, WHO, IWA, 2015
8. Directive (EU) 2020/2184 of the European Parliament and of the Council of 16 December 2020 on the quality of water intended for human consumption

### Additional

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

## Breakdown of average student's workload

|   | Hours | ECTS |
|---|-------|------|
| Total workload  | 50    | 2,0  |
| Classes requiring direct contact with the teacher   | 18    | 0,5  |
| Student's own work (literature studies, solving problems - homework, preparation for final test) <sup>1</sup> | 32    | 1,5  |

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