STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Reliability and Safety of Engineering Systems**		Code **1010102231010133958**
Field of study **Environmental Engineering Second-cycle**	Profile of study (general academic, practical) **(brak)**	Year /Semester **2 / 3**
Elective path/specialty **Heating, Air Conditioning and Air Protection**	Subject offered in: **Polish**	Course (compulsory, elective) **obligatory**
Cycle of study: **Second-cycle studies**	Form of study (full-time,part-time) **full-time**	
No. of hours Lecture: **15** Classes: **-** Laboratory: **-** Project/seminars: **-**		No. of credits **1**
Status of the course in the study program (Basic, major, other) **(brak)**	(university-wide, from another field) **(brak)**	
Education areas and fields of science and art **technical sciences** **Technical sciences**		ECTS distribution (number and %) **1 100%** **1 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Mathematical logic, combinatorics and probability theory, random variables, probability distributions of typical random variables at the 6th KRK level
2	**Skills**	Identification of random variables, probability calculation of random events, calculations of expected values of discrete and continuous random variables at 6th KRK level
3	**Social competencies**	Consciousness of necessity of permanent updating extending of skills and knowledge

Assumptions and objectives of the course:

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.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Student knows and understand definitions of basic reliability parameters of technical systems and their applications (achieved during lectures) - [K2_W04]
2. Student has systematic knowledge about reliability structures of technical systems and about properties of these structures (achieved during lectures) - [K2_W04, K2_W06]
3. Student knows basic methods for reliability analysis of technical systems such as ?Event Tree Analysis? and ?Fault Tree Analysis? (achieved during lectures) - [K2_W04]
4. Student understands the concept of ?risk? in safety engineering and knows basic rules of risk estimation in engineering (achieved during lectures) - [K2_W04, K2_W06, K2_W08]

Skills:

1. Student is able to recognize reliability structure of simple technical system and to estimate value of its reliability (achieved during lectures) - [K2_U11, K2_U16, K2_U17]
2. Student can calculate reliability parameters of typical engineering structures (achieved during lectures) - [K2_U11, K2_U16, K2_U17]
3. Student is able to apply ?Event Tree Analysis? and ?Fault Tree Analysis? for risk calculations of technical systems (achieved during lectures) - [K2_U11, K2_U16, K2_U17]
4. Student can calculate risk of technical system operation and is able to show method of the risk reduction (achieved during lectures) - [K2_U11, K2_U16, K2_U17]

Social competencies:
1. Student understands necessity of collective work in order to solve problems of reliability and safety in environmental engineering (achieved during lectures) - [K2_K03]
2. Student is aware of necessity of permanent development of his professional skills and competence (achieved during lectures) - [K2_K01]
3. Student is able to inform the society about reliability and safety problems of contemporary environmental engineering systems (achieved during lectures) - [K2_K07]

Assessment methods of study outcomes

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)

Course description

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. Criterions 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?.

Method of teaching: classical lecture with elements of conversation and Power Point presentation.

Basic bibliography:

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 bibliography:

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures (contact hours)	15
2. Participation in consultations related to the lectures (contact hours)	3
3. Preparation for the final test and the present at the test (autonomus learning)	15

Student's workload

Source of workload	hours	ECTS
Total workload	33	1
Contact hours	18	0
Practical activities	0	0