(*faculty stamp*)

COURSE DESCRIPTION

1. Course title: RELIABILITY AND INTRINSIC SAFETY	**2. Course code**
3. Validity of course description: 2016/2017	
4. Level of studies: BSc programme / ~~MSc programme~~	
5. Mode of studies: intramural studies	
6. Field of study: MACROCOURSE	(FACULTY SYMBOL) AEII
7. Profile of studies: general	
8. Programme: Automatic	
9. Semester: 6	
10. Faculty teaching the course: Institute of Automatic Control, Rau1	
11. Course instructor: dr inż. Andrzej Kozyra	
12. Course classification: programme courses	
13. Course status: ~~compulsory~~ /elective	
14. Language of instruction: English	
15. Pre-requisite qualifications: It is assumed that prior to learning this course, students have a background in probability and statistics, solving linear differential equations using Laplace transform.	
16. Course objectives: Objectives of the lectures is to acquaint the students with: 1). A necessity of reliability assessment of technical objects and systems. 2.) Reliability analysis methods in which reliability structures, maintenance and a human role are taken into account. 3). Constructions of explosion-proof apparatus and designing of measurement and automatic control systems with intelligent transducers, as an intrinsically safe systems, in which the reliability plays the most important role. Laboratory exercises aim is: 1). To acquire ability to evaluate reliability of electronics circuits, equipment and systems by using computer programs 2) To familiarize with building an intrinsically safe control and measurement systems in which reliability plays an important role.	
17. Description of learning outcomes:	

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Student knows the methods of reliability analysis of technical objects and systems.	Written test, Laboratory exercise, Preparation of reports	Classical lecture, Laboratory exercise	K_W17 K_U02 K_U07 K_W21
2.	Student knows the meaning of basic concepts: reliability, unreliability, failure rate, MTTF, MTBF, MTTFF. Methods of determination reliability factors.	Written test, Laboratory exercise, Preparation of reports	Classical lecture, Laboratory exercise	K_W17 K_W22 K_U07 K_W21
3.	Student is understood that work in some areas can cause risk of explosion. He knows conditions in which explosive atmosphere can occur and he knows what could be a source of ignition.	Written test, Laboratory exercise	Multimedia presentation, Laboratory exercise	K_W22 K_U25 K_K02 K_K05 K_U26
4.	Student is able to estimate the reliability of electronics circuit.	Laboratory exercise, Preparation of reports	Classical lecture, Laboratory exercise	K_W04 K_U03
5.	Student is able to assess the reliability of the system and the technical object by using proper methods: modular decomposition, fault tree analysis, Markov graphs.	Written test, Laboratory exercise, Preparation of reports	Classical lecture, Laboratory exercise	K_W21 K_U07

6.	Student is able to estimate the probability of human error.	Written test	Classical lecture	K_K02 K_U03
7.	He is aware of what the consequences may cause neglect in terms of reliability, safety, improper operation of equipment in hazardous areas.	Laboratory exercise, Preparation of reports	Multimedia presentation, Laboratory exercise	K_W22 K_U25 K_K02
8.	Can present, he knows when to use, what limitations have methods for estimating reliability.	Presentation of laboratory reports	Laboratory exercise	K_W01 K_U02 K_K02

18. Teaching modes and hours

Lecture / BA /MA Seminar / Class / Project / Laboratory

Sem 5 - 30 h., Sem 6 - 30 h

19. Syllabus description:

Semester 5 :

Lectures

Reliability:

1. Introduction to the subject. Basic terms: component, system, damage to objects, forcing factors, reliability R(t), frequency of failures f(t), intensity of failures λ(t). Mean time to first failure (MTTFF). Mean time between failures (MTBF).

2. Probability distributions common used in reliability. Wiener's formula. The exponential law of reliability. The bathtub curve.

3. Estimation of reliability of elements. Estimating the reliability of electronic systems. Standard MilHdbk 217, Hdbk217plus.

4. Reliability structures: static (serial, parallel, threshold), dynamic (cascade, hybrid). Modular decomposition methods. Fault Tree Analysis. Reserving.

5. Reliability model of non-repairable system: assumptions, graph, matrix of states, system of equations, examples of calculation of measures of reliability: R(t), λ, MTBF, MTTFF.

6. Reliability of repairable system: assumptions, graph, matrix of states, system of equations, examples of calculation of measures of reliability: availability function A(t), availability A, MTBF, MTTFF.

7. Human error assessment; Human Error Assessment and Reduction Technique (HEART).

8. Functional safety of electrical/electronic/programmable electronic safety-related systems IEC 61508.

Intrinsic Safety:

9. Characteristics of gases, vapours and dust in terms of explosiveness. Classifications of gases, dust, equipment and areas. Basic terms: the probability of ignition, minimum ignition energy, minimum current of the ignition.

10. Types of explosion protection. Standard IEC spark test apparatus for intrinsically safe circuits. Procedure for validation of intrinsically safe circuits. Equipment marking and systems with explosion protection.

11. Standardization in the field of explosion protection. Institutions and national and international standards. Attesting institutions, the recognition of foreign certificates.

Laboratory

1. NUE - Assessment of the reliability of electronic circuits. The purpose of this exercise is to solve the problem for estimating reliability of electronic systems. Students use reliability analysis methods described in international standards MIL-HDBK-217 and IEC 62380.

2. NSZ - Evaluation of reliability of complex systems. The purpose of this exercise is to acquire the skills reliability analysis of complex systems with static reliability structure by using specialized computer programs. Method of teaching: a case study - solve the problem reliability assessment of the system with static reliability structure.

3. STR - The basic reliability structures of the systems. The purpose of this exercise is to acquire the skills of reliability analysis by using Markov analysis. Creating: a graph, equations of states and the determination of basic indicators of reliability of the system. Method of teaching: a case study - solution to the problem of reliability evaluation of selected electronic system.

4. STD - Estimating the reliability of systems with dynamic reliability structure. Students solve the problem of estimating the reliability of systems using graph states and specialized software.

5. FUZ - Using fuzzy sets in the evaluation of reliability. The purpose of this exercise is to acquire the skills to use fuzzy set theory in reliability issues. Students create fuzzy logic reliability models of selected systems in LabView.

6. PDP - Intrinsically safe, modular system with PROFIBUS-DP. The purpose of exercises to acquaint the modern, industrial measurement system which enables measurements in hazardous areas. Students learn how to select of the components of system in order to apply it in a specific application.

7-8. AN1, AN2 – Reliability analysis of a complex system with increased reliability. Students have the opportunity to use all the knowledge gained during lectures and previous laboratory exercises to determine various reliability parameters of the chosen system.

20. Examination: NO. The test after the lectures, completion laboratory exercises.

21. Primary sources:

1. Instrument Engineers' Handbook, Process Measurement and Analysis, Vol. I, Lipták B. G. Editor-in-chief, ISA-The Instrumentation, Systems, and Automation Society, CRC Press, Boca Raton London New York Washington, D.C. 2003.

22. Secondary sources:

1. De Carlo J.P: Fundamentals of flow measurement, Instrument Society of America, Research Triangle Park, 1984.
2. EN 61298-2 Process measurement and control device – General methods and procedure for evaluating performance Part 2: Test under reference conditions (IEC 1298-2: 1995).
3. Flow Handbook. A Practical Guide: Measurement Technologies – Applications – Solutions, Endress+Hauser Flowtec AG, CH-4153 Reinach/BL, 2004.
4. Guide to the Expression of Uncertainty in Measurement, International Organization for Standardization, 1993.
5. http://www.profibus.com
6. Mc Ghee J., Korczyński M.J., Henderson I.A., Kulesza W.: Scientific Metrology, Technical University of Łódź, Łódź 1996, ISBN 83-904299-9-3
7. Waluś S.: The Mathematical Modelling of Flowmeter Sensors, Akustyka Molekularna i Kwantowa, tom 19, Oddział Górnośląski PTA, Instytut Fizyki Politechniki Śląskiej, Sekcja Akustyki Molekularnej i Kwantowej PTA, Sekcja Akustyki Fizycznej Komitetu Akustyki PAN, Gliwice 1996, s. 275-286.

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	15/10
2	Classes	0/0
3	Laboratory	15/15
4	Project	0/0
5	BA/ MA Seminar	0/0
6	Other	0/0
	Total number of hours	30/25

24. Total hours:55

25. Number of ECTS credits: 2

26. Number of ECTS credits allocated for contact hours: 2

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects):1

26. Comments:

Approved:

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(date, Instructor's signature)

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(*date , the Director of the Faculty Unit signature)*