COURSE DESCRIPTION CARD - SYLLABUS

Course name
Functional Safety [S2Inf1E-CYB>BFUN]

Course

Field of study
Computing

Year/Semester
1/1

Area of study (specialization)
Cybersecurity

Profile of study
general academic

Level of study
second-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

A student starting this course should have basic knowledge of computer networks, computer operating systems (Windows, Linux), and know at least one programing language (such as C, C++, or Java). He should also have the ability to obtain information from the indicated sources and be ready to cooperate as part of the team.

Course objective

Providing students with detailed theoretical and practical knowledge in the field of functional safety, threat detection, risk analysis and evaluation, and cost estimation of developing and applying safety computer control system implementation. As part of the course, resilient computer systems will be discussed.

Course-related learning outcomes

Knowledge:
student has a structured and theoretically founded general knowledge related to key issues in the field of functional safety as well as threat analysis and estimations.
has advanced detailed knowledge regarding safety computer control systems.
has advanced and detailed knowledge of the processes occurring in the life cycle of resilient computer

systems.
knows advanced methods, techniques and tools used to identify threats, risk analysis and estimations as well as knows methods of probabilistic modeling of e/e/ep systems

Skills:
student is able to obtain information from literature, databases and other sources , such as standards and recommendation, (both in polish and english) in the field of functional safety, integrate them, interpret and critically evaluate them, draw conclusions and formulate and fully justify opinions
is able to plan and carry out experiments, including computer measurements and simulations, interpret the obtained results and draw conclusions and formulate and verify hypotheses related to complex engineering problems in the field of functional safety.
can use analytical, simulation and experimental methods to formulate and solve engineering problems and simple research problems
can carry out a critical analysis of existing technical solutions and propose their improvements.
is able to interact in a team, taking various roles in it.
can determine the directions of further learning and implement the process of self-education in the field of functional safety and safety integrity levels.

Social competences:
student understands that in the field functional safety, knowledge and skills very quickly become obsolete.
understands the importance of using the latest knowledge in the field of functional safety in solving research and practical problems.
is aware of the need for a professional approach to solving functional safety problems and taking responsibility for the projects he proposes.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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Learning outcomes are verified with a written or oral test. Test in written form consists 7-10 question (multichoice and open), which are scored in different ways (there are three or four groups of scores). Test in oral form contains 50-60 open questions divided into three or four score groups. Students draw one question from each group. In the oral form, for each question teacher can ask one additional question. Both, main and additional questions are scored, taking into account content range and understanding the issue. Minimum number of scores to pass the exam is equal to 50%.

Skills acquired as part of the laboratory are verified on an ongoing basis. At the end of each laboratory class, the correctness of configuration of network devices is assessed on a scale of 0 to 10 points. Minimum number of scores to pass the exam is equal to 50%. The assessment levels (lecture and tutorials) are the following:

Number of scores mark
<=50% 2,0
51% - 60% 3,0
61% - 70% 3,5
71% - 80% 4,0
81% - 90% 4,5
91% - 100% 5,0

Programme content

The program covers the basic elements of functional safety: vulnerabilities, errors, failures, SIS (Safety Instrumented Systems), SIF (Safety Instrumented Functions), and SIL (Safety Integrity Levels). It also discusses the fundamental standards in this area and presents methods for hazard estimation.

Course topics

The following topics will be discussed as part of the lecture:
• The meaning of safety integrity targets

• Architectural constraints, hardware failures, and fault tolerance
• Recommendations regarding functional safety (IEC 61508, IEC 61511, and others)
• SIL targeting and functional safety maintenance
• Human factors
• Requirements for E/E/EP systems regarding functional safety
• Functional safety in digital communication
• Functional safety in ASICs, PLCs, and integrated circuits
• Threat identification methods, risk analysis and evaluation, analysis of layers and rings of threats
• Modeling of E/E/EP systems for risk analysis and evaluation
• Cost and effects analysis
• Recommendations regarding system engineering, safety of computer control systems, and programming
• Recommendations and standards regarding quality maintenance and SIL
• Resilient computer systems:
- Generalized algorithm for fault tolerance.
- Testing, checking, and hardware syndrome
- Recovery preparation and recovery algorithms
- Programming Language for Safety Critical Systems
- C language in critical systems (MISRA-C)

Laboratory topics:
In line with the content of lectures.

Teaching methods

Informative lecture: multimedia presentation, illustrated with examples on the board.
Laboratory exercises: practical exercises in groups using network devices and a virtualized environment.

Bibliography

Basic
1. David J Smith, Kenneth G L Simpson: The Safety Critical Systems Handbook: A Straightforward Guide to Functional Safety: IEC 61508 (2010 Edition), Iec 61511 (2015 Edition) and Related Guidance, Butterworth-Heinemann, 2020,
2. Schagaev Igor., Kaegi-Trachsel Thomas: Software Design for Resilient Computer Systems, Springer International Publishing, 2016.

Additional
1. Josef Börcsök: Functional Safety: Basic Principles of Safety-related Systems, Vde Verlag GmbH, 2021.
2. Harvey T. Dearden: Functional Safety In Practice (3rd Edition), Independently Published, 2020.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00