GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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| Subject name and code | Functional safety in hydrogen technologies, PG_00058354 | | | | | | |
| Field of study | Hydrogen Technologies and Electromobility | | | | | | |
| Date of commencement of studies | October 2023 | | | Academic year of realisation of subject | | 2025/2026 | |
| Education level | first-cycle studies | | | Subject group | | Obligatory subject group in the field of study<br>Subject group related to scientific research in the field of study | |
| Mode of study | Full-time studies | | | Mode of delivery | | at the university | |
| Year of study | 3 | | | Language of instruction | | Polish | |
| Semester of study | 5 | | | ECTS credits | | 4.0 | |
| Learning profile | general academic profile | | | Assessment form | | assessment | |
| Conducting unit | Department of Control Engineering -> Faculty of Electrical and Control Engineering | | | | | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | | dr hab. inż. Marcin Śliwiński | | | | |
| | Teachers | | | | | | |
| Lesson types and methods of instruction | Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
| | Number of study hours | 30.0 | 0.0 | 30.0 | 0.0 | 0.0 | 60 |
| | E-learning hours included: 0.0 | | | | | | |
| Learning activity and number of study hours | Learning activity | Participation in didactic classes included in study plan | | Participation in consultation hours | Self-study | | SUM |
| | Number of study hours | 60 | | 7.0 | 33.0 | | 100 |
| Subject objectives | Providing students with advanced engineering knowledge regarding hazard identification and analysis risk assessment in hydrogen installations useful in the design of control systems taking into account functional safety requirements in hydrogen technologies. | | | | | | |

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| Learning outcomes | (see table below) |

| Course outcome | Subject outcome | Method of verification |
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| [K6_W07] knows the basics of computer programming, digital circuits, microprocessor technology, design of simple algorithms, principles of operation of computer networks | The student is able to use knowledge of selected methods and tools to support the design process use of control systems performing safety functions. | [SW3] Assessment of knowledge contained in written work and projects<br>[SW1] Assessment of factual knowledge |
| [K6_W14] knows and understands at an advanced level the principles, methods and techniques of programming and the principles of creating computer software or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, as well as the organization of the work of systems using computers or these devices | The student knows the possibilities of using advanced computer applications in the process of integrated functional safety and<br>cybersecurity analyses of industrial automation and control systems (IACS) in<br>life cycle of complex hydrogen installations. | [SW3] Assessment of knowledge contained in written work and projects<br>[SW2] Assessment of knowledge contained in presentation |
| [K6_U07] can build and analyze models of systems and systems in the field related to hydrogen devices and installations as well as control and automation systems | The student is able to make identification<br>threats and carry out risk analyzes and assessments regarding design and<br>use of control systems<br>elevated hydrogen installations<br>risk taking into account<br>the concept of Industry 4.0 and 5.0. | [SU4] Assessment of ability to use methods and tools<br>[SU3] Assessment of ability to use knowledge gained from the subject |
| [K6_U12] can formulate a specification of simple engineering tasks of a practical nature related to the field of study | The student is able to design and verify the safety function<br>safety function implemented in a control system for a hydrogen system with a user interface on a laboratory bench. | [SU4] Assessment of ability to use methods and tools<br>[SU1] Assessment of task fulfilment |
| [K6_K01] is aware of the need for continuous education and self-improvement in the field of the profession of an electrician and knows the possibilities of further education | The student knows the rules of determination<br>SIL levels (Safety Integrity Level) safety functions on<br>based on defined matrices<br>risk and modified risk graphs. | [SK3] Assessment of ability to organize work<br>[SK1] Assessment of group work skills<br>[SK5] Assessment of ability to solve problems that arise in practice |
| [K6_W12] knows the hazards from electrical equipment, ways to reduce these hazards, basic principles of health and safety at work with electrical devices, basic principles of ergonomics | The student knows methods of verifying SIL safety integrity levels taking into account<br>modeling results<br>probabilistic system<br>controlling a hydrogen installation with a given architecture. | [SW1] Assessment of factual knowledge<br>[SW3] Assessment of knowledge contained in written work and projects |

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| Subject contents | LECTURE Risk definitions, individual and social risk. ALARP principle, risk matrix and required risk reduction. The concept of functional safety of control and security systems. Design of electrical/electronic and programmable electronic (E/E/PE) systems. Examples of functional safety solutions in industry. Threat analysis and function definition related to security. Determining the SIL safety integrity level based on risk assessment according to PN-EN 61508. DC diagnostic coverage in subsystems. SIL verification qualitative and quantitative methods. Protection and protection layers according to PN-EN 61511. Method LOPA. Design of SIS security instrument functions and the AS alarm system.<br><br>LABORATORY EXERCISES Determining the required SIL for safety-related functions. SIL level verification, design and implementation of the structure of the KooN safety system. Application drivers safety. Safety layers (BPCS, human operator and alarm system, SIS/ESD). |
| Prerequisites and co-requisites | |
| Assessment methods and criteria | (see table below) |

| Subject passing criteria | Passing threshold | Percentage of the final grade |
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| Practical exercises in lab, | 60.0% | 35.0% |
| Two tests - theory/tasks | 60.0% | 65.0% |

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| Recommended reading | Basic literature | 1. Kosmowski K.T. (red.): Podstawy bezpieczeństwa funkcjonalnego, Wydawnictwo Politechniki Gdańskiej, Gdańsk 2020.<br>2. Kosmowski K.T. (red.): Functional safety management in critical systems, Gdańsk, 2008.<br>3. Liderman K.: Analiza ryzyka i ochrona informacji w systemach komputerowych. Wydawnictwo Naukowe PWN SA, Warszawa 2008. |

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| | Supplementary literature | 1. Andersen R.: Inżynieria zabezpieczeń. WNT 2005.<br>2. Białas A.: Bezpieczeństwo informacji i usług w nowoczesnej instytucji i firmie, WNT, Warszawa, 2006. |
| | eResources addresses | Adresy na platformie eNauczanie: |
| Example issues/<br>example questions/<br>tasks being completed | 1. Risk graph for determining the required Safety Integrity Level (SIL).<br>2. Qualitative SIL verification of the E/E/PE system.<br>3. Quantitative SIL verification of the E/E/PE system. | |
| Work placement | Not applicable | |