GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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| Subject name and code | Protection Systems in the Industry, PG_00059283 | | |
| Field of study | Automation, Robotics and Control Systems | | |
| Date of commencement of studies | February 2023 | Academic year of realisation of subject | 2023/2024 |
| Education level | second-cycle studies | Subject group | |
| Mode of study | Full-time studies | Mode of delivery | at the university |
| Year of study | 1 | Language of instruction | Polish |
| Semester of study | 2 | ECTS credits | 3.0 |
| 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 | dr hab. inż. Marcin Śliwiński<br>dr inż. Adam Kielak<br>dr inż. Emilian Piesik | |

**Lesson types and methods of instruction**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 30.0 | 0.0 | 0.0 | 15.0 | 0.0 | 45 |

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 |
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| Number of study hours | 45 | 5.0 | 25.0 | 75 |

**Subject objectives**

Familiarize students with methods of analysis and design of industrial safety systems.

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
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| K7_U07 | The student is able to design and verify the safety function along with the user interface at the laboratory station. | [SU5] Assessment of ability to present the results of task<br>[SU4] Assessment of ability to use methods and tools<br>[SU1] Assessment of task fulfilment |
| K7_W13 | The student has knowledge of hazard identification and defining security functions to be implemented in the Industrial Control System (ICS) according to the functional safety concept (IEC 61508) and relevant sectoral standards taking into account cybersecurity aspects (IEC 62443). | [SW3] Assessment of knowledge contained in written work and projects<br>[SW1] Assessment of factual knowledge |
| K7_W09 | The student knows the principles of determining the levels: PL (Performance Level) and SIL (Safety Integrity Level) of safety functions on the basis of defined risk matrices and the method of verifying these levels taking into account the results of modeling a probabilistic control system with a given architecture. | [SW3] Assessment of knowledge contained in written work and projects<br>[SW1] Assessment of factual knowledge |

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| Subject contents | Examples of security systems in various sectors of the economy. Advanced methods of analyzing the reliability and safety of technical systems. Probabilistic modeling of objects. Mechanisms of damage to elements in security systems and models. Analysis of types, effects and failure criticality (FMECA) of programmable systems. Advanced reliability analysis of systems assembled by various methods: reliability flowcharts (RDB), damage and error tree (FT), event trees (ET) and Markov graphs (MG). Optimize reliability. The requirements of the PN-EN 61508 standard and its relations with the sectoral standards PN-EN 61511 and PN-EN 62061. Individual and social risk. Hazard identification, analysis and assessment. Objectives and concept of life-cycle functional safety management. Analysis of industrial installations using the HAZOP method. Defining safety-related functions. Define failover scenarios. Determination of the required sil safety integrity level based on risk analysis and assessment; risk matrix method. Potential biases in E/E/PE systems and error avoidance. Software quality and lifecycle requirements. Protection of computer networks. Architectural limitations in E/E/PE subsystems. Verification of the SIL level under conditions of uncertainty. Dependent damage and its elimination. Analysis of LOPA security layers in relation to PN-EN 61511. Human factors in the analysis of functional safety and security layers; functional analysis, design of interfaces and alarm system. Requirements for functional safety of machine control systems according to PN-EN 62061. E/E/PE systems testing strategy. |
| Prerequisites and co-requisites | Knowledge of reliability analysis in technical systems, programmable technologies and computer systems in industry and the economy. |

Assessment methods and criteria

| Subject passing criteria | Passing threshold | Percentage of the final grade |
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| Colloquium I | 50.0% | 25.0% |
| Project | 50.0% | 50.0% |
| Colloquium II | 50.0% | 25.0% |

Recommended reading

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| Basic literature | 1. Hoyland A., Rausand M.: System Reliability Theory. Models and Statistical Methods. New York: John Wiley & Sons, Inc. 1994.<br><br>2. Teaching materials are available on the website "Zespół Technologii Sieciowych i Inżynierii Bezpieczeństwa".<br><br>3. Kosmowski K.T.(red.): Podstawy bezpieczeństwa funkcjonalnego, Wydawnictwo PG. Gdańsk, 2016-2020 (III wyd.).<br><br>4. Podstawy komputerowej aplikacji CARE (BQR).<br><br>5. Wprowadzenie do oprogramowania Pro-SIL. WEiA PG, 2010. |
| Supplementary literature | 1. MIL-HDBK-217F. Reliability Prediction of Electronic Equipment. Washington, DC: U.S. Department of Defence, 1991.<br><br>2. MIL-STD-1629A. Procedures for performing a failure mode, effects and criticality analysis. Washington, DC: U.S. Department of Defence, 1980 |
| eResources addresses | Adresy na platformie eNauczanie:<br>SYSTEMY ZABEZPIECZEŃ W PRZEMYŚLE [2023/24] - Moodle ID: 33883<br>https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33883 |

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| Example issues/ example questions/ tasks being completed | Hazard identification and risk assessment aimed at determining pl or SIL safety functions.<br><br>Designing the architecture of the industrial installation security system taking into account the requirements of functional safety.<br><br>Safety Integrity Level (SIL) of safety functions and probabilistic criteria. |
| Work placement | Not applicable |