COURSE DESCRIPTION CARD - SYLLABUS

Course name
Human Error Analysis and Modelling [S1DSwB1>AiMBL]

Course

Field of study
Data Science in Business

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
15

Projects/seminars
0

Number of credit points

3,00

Coordinators

dr hab. inż. Marcin Butlewski prof. PP
marcin.butlewski@put.poznan.pl

Lecturers

Prerequisites

Basic knowledge of work processes and production.

Course objective

The course aims to develop the ability to identify, analyze, and model human errors in technical and organizational systems, with a particular focus on their causes, consequences, and mitigation methods. Students will learn about classifications and models of errors, psychological and cognitive mechanisms of their occurrence, as well as risk assessment and error management methods in high-risk environments. The course emphasizes the use of modern analytical tools and modeling of human- machine interactions in the context of automation and Industry 4.0.

Course-related learning outcomes

Knowledge:
Characterizes human-machine-environment interaction models and the principles of cognitive ergonomics in the context of automation and decision support systems [DSB1_W05].
Describes methods for analyzing and modeling work systems and human errors in high-risk environments, considering their application in Industry 4.0 [DSB1_W06].

Skills:
(DSB1_U03): Can design and conduct analytical experiments and computer simulations related to data analysis, human-system interaction, interpret results, and draw conclusions relevant to business decision-making.
(DSB1_U06): Can analyze systemic and non-technical aspects of data analysis, including ethical, legal, economic, and ergonomic consequences of implemented solutions.

Social competences:
Analyzes the impact of ergonomic factors on the safety and effectiveness of work systems and predicts the consequences of their misalignment [DSB1_U07].
Selects and applies methods for identifying and analyzing human errors, such as HAZOP, FMEA, SHERPA,
or CREAM, depending on the system's specifics [DSB1_U02].
Models and evaluates human-machine interaction systems, considering the impact of automation, artificial intelligence, and new technologies on human work [DSB1_U08].
Designs strategies for minimizing human errors and managing fatigue and stress in high-responsibility environments [DSB1_U10].
Analyzes the risk associated with users' cognitive limitations and their impact on decision-making under uncertainty [DSB1_U07].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:
Exercises: Ongoing knowledge and skills checks during exercises.
Lectures: Discussions based on materials from previous lectures.
Laboratory: Completion of laboratory tasks and ongoing knowledge assessment.
Summative assessment:
Exercises: Based on the average grades from formative assessments.
Lectures: Knowledge test.
Laboratory: Reports on completed tasks with the ability to defend conclusions.

Programme content

The program covers the history and models of human errors (SRK, SHELL, Swiss Cheese) and their analysis across various industries. It addresses psychological aspects of making errors, the impact of fatigue, and the responsibility division between humans and machines. The course presents methods for error identification (HAZOP, FMEA, SHERPA, CREAM) and modeling in the context of automation and Industry 4.0. It includes forecasting and managing errors in high-risk environments, considering cognitive ergonomics.

Course topics

History and significance of human error research - evolution of error analysis approaches from aviation and nuclear energy to automation, medicine, and autonomous systems.
Classification and models of human errors - overview of SRK, SHELL, and Reason’s (Swiss Cheese) models and their application in risk analysis.
Psychological and cognitive aspects of errors - impact of perception, attention, memory, stress, and information overload on error susceptibility.
Fatigue management, boundaries of human and machine responsibility - impact of working hours, circadian rhythm, and interventions reducing errors.
Methods for error identification and analysis - qualitative and quantitative tools, including HAZOP, FMEA, SHERPA, CREAM, and root cause analysis.
Modeling human errors in automation and Industry 4.0 - modeling human-machine interactions.
Forecasting, modeling, and managing errors in high-risk environments - probabilistic approaches, error mitigation strategies, and the role of cognitive ergonomics.

Teaching methods

• Lectures with multimedia presentations.

• Problem-solving exercises related to lecture topics.
• Experiment laboratories related to lecture topics..

Bibliography

Basic:
INCOSE Systems Engineering Handbook, San Diego, CA: INCOSE, 2010.
Butlewski, M. (2018). Projektowanie ergonomiczne wobec dynamiki deficytu zasobów ludzkich, Poznań University of Technology, ISBN: 978-83-7775-506-8, 255 pages.
Pokorski, J., Pokorska, J., & Złowodzki, M. (2010). Błąd medyczny. Uwarunkowania ergonomiczne, Kraków.

Additional:
Blanchard, B. S. (2004). System Engineering Management, John Wiley & Sons.
Handbook of Human Factors and Ergonomics (Salvendy & Karwowski), 5th edition, Wiley, 2021, ISBN 9781119636083.
Butlewski, M., Jasiulewicz-Kaczmarek, M., Misztal, A., & Sławińska, M. (2014, September). Design methods of reducing human error in practice. In Safety and Reliability: Methodology and Applications - Proceedings of the European Safety and Reliability Conference ESREL (pp. 1101-1106).

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	47	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	28	1,00