



COURSE CARD

1. Basic information

Course name in English:	Dependable Systems: Design Methods & Implementations	
Course name in Polish:	Systemy wiarygodne: metody projektowania i implementacje	
Number of hours:	30	
Type of course:	Elective course	
Form of course:	lecture	
Code of course:		
Course leader:	<i>Stanisław J. Piestrak, PhD, DSc, WUST Professor</i>	
Faculty of the course leader:	W4 Faculty of Information and Communication Technology	
Email address of the course leader:	stanislaw.piestrak@pwr.edu.pl	
Scientific discipline(s) assigned to the course (doctoral students representing the marked disciplines can participate in the course):	Architecture and urban planning	☐
	Automation, electronic, electrical engineering and space technologies	☐
	Information and communication technology	☒
	Biomedical engineering	☐
	Chemical engineering	☐
	Civil engineering, geodesy and transport	☐
	Materials engineering	☐
	Mechanical engineering	☐
	Environmental engineering, mining, and energy	☐
	Mathematics	☐
	Chemical sciences	☐
	Physical sciences	☐
	Management and quality studies	☐

2. Objectives

Despite a continuous progress observed in the semiconductor and computer industry, ensuring dependable (correct) functioning of computer systems by using special design techniques still remains a major issue. A number of recent trends, such as a growing number of applications in harsh environments, novice users, critical applications, larger and more complex systems, and high downtime costs, have accelerated interest in making computer systems dependable. The primary goal of dependability is to avoid downtime and to ensure correct and safe operation even in the presence of faults. Some of the sample special requirements regarding dependability aspects of computer systems are: high availability, long life, continuous operation, postponed maintenance, high-performance error-free computing, and critical applications (in which human health or life could be in danger). This lecture is a tutorial on techniques of designing dependable digital systems. The importance of this topic was confirmed by the most recent incident



of 29 Nov. 2025, when about 6000 of Airbus A320 planes were briefly grounded following a warning that solar radiation could interfere with onboard computers.

3. Content

Detailed information about the course content, including topics and form of classes.

No.	Topic	Number of hours	Form of classes
1	Introduction	2	lecture
2	Basic dependability concepts: - Dependability attributes: Availability, reliability, safety, confidentiality, integrity, maintainability - Dependability impairments: Faults, errors, and failures - Techniques of error processing and fault treatment - Fault modeling	6	lecture
3	Introduction to computer system reliability modeling	2	lecture
4	Fault avoidance techniques	2	lecture
5	Fault-tolerance techniques: - Information redundancy techniques - Hardware redundancy techniques - Time redundancy techniques - Software redundancy techniques	8	lecture
6	Safety critical systems	2	lecture
7	Fault-tolerance methods for sensors and data acquisition	2	lecture
8	Dependability features of some modern commercial digital systems: - Fault-tolerant reconfigurable systems using Field-Programmable Logic Arrays (FPGAs) - Fault-tolerant data storage systems: Redundant Arrays of Independent Disks (RAID) - Dependability features of servers	6	lecture

4. Prerequisites

List of prerequisites relating to knowledge, skills and other competences for course participants.

Elementary knowledge of digital circuits and computer architecture

5. Learning outcomes

List of learning outcomes at level 8 of the Polish Qualifications Framework assigned to the course (mark the learning outcomes in the last column).

Symbol	Learning outcome	
	KNOWLEDGE. Doctoral student knows and understands:	
SzD_W3	the main trends in the development of the scientific or artistic disciplines covered	☒



	in the curricula;	
SzD_W4	research methodology;	☐
SzD_W5	the rules for the dissemination of scientific results, including in open access mode;	☐
SzD_W6	the fundamental dilemmas of modern civilization;	☐
SzD_W7	the legal and ethical conditions of scientific activity;	☐
SzD_W8	the economic and other relevant conditions of scientific activity;	☐
SzD_W9	basic principles of knowledge transfer to the economic and social spheres and commercialisation of results of scientific activity and know-how related to these results.	☐
SKILLS. Doctoral student is able to:		
SzD_U2	use knowledge from different fields of science or art to creatively identify, formulate and innovatively solve complex problems or perform research tasks, in particular: - define the purpose and subject of scientific research, formulate a research hypothesis, - develop research methods, techniques and tools, and use them creatively, - draw conclusions on the basis of scientific research; critically analyse and evaluate the results of scientific research, expertise and other creative work and their contribution to knowledge development; transfer the results of scientific activities to the economic and social spheres;	☐ X
SzD_U3	communicate on specialised topics to the extent that they enable an active participation in the international scientific community;	☐
SzD_U4	disseminate research results, including in popular forms;	☐
SzD_U5	initiate debates and participate in a scientific discourse;	☐
SzD_U6	be able to speak a foreign language at B2 level of the Common European Framework of Reference for Languages to a level that enables them to participate in the international scientific and professional environment;	☐
SzD_U7	plan and implement an individual or collective research or creative activity, including in an international environment;	☐
SzD_U8	independently plan and act for one's own development and inspire and organize the development of others;	☐
SzD_U9	plan classes or groups of classes and implement them using modern methods and tools.	☐
SOCIAL COMPETENCES. Doctoral student is ready to:		
SzD_K3	fulfilling the social obligations of researchers and creators, initiate public interest activities, thinking and acting in an entrepreneurial way;	☐ X
SzD_K4	maintaining and developing the ethos of research and creative environments, including: - carrying out scientific activities in an independent manner, - respecting the principle of public ownership of research results, taking into account the principles of intellectual property protection.	☐

6. Evaluation



Short description of the method(s) used to evaluate the learning outcomes assigned to the course, e.g., exam, test, report, presentation, etc.

exam

7. Teaching methods

Short description of the teaching methods used during the course, e.g., multimedia presentation, discussion, literature studies, developing written documents, own work, etc.

beamer presentation

8. Literature

List of primary and secondary literature used to prepare the course and including additional knowledge for participants, e.g., books, textbooks, research papers, standards, web pages, etc.

- [1] B. S. Dhillon, "System Safety, Maintainability, and Maintenance for Engineers," CRC Press, 2023.
- [2] H. B. Diab and A. Y. Zomaya, Eds., "Dependable Computing Systems: Paradigms, Performance Issues, & Applications," Wiley, 2005.
- [3] R. K. Iyer, Z. T. Kalbarczyk, and N. M. Nakka, "Dependable Computing: Design and Assessment," IEEE/Wiley, 2024.
- [4] F. Kastensmidt and P. Rech, Eds., "FPGAs and Parallel Architectures for Aerospace Applications," Springer, 2015.
- [5] V. K. Khanna, "Extreme-Temperature and Harsh-Environment Electronics: Physics, Technology and Applications", 2nd Edition, IOP Publishing Ltd, 2023.
- [6] I. Koren and C. M. Krishna, "Fault-Tolerant Systems," 2nd Edition, Morgan Kaufmann Publ., 2020.
- [7] M. L. Shooman, "Reliability of Computer Systems and Networks: Fault Tolerance, Analysis and Design," Wiley, 2002.
- [8] A. Thomasian, "Storage Systems: Organization, Performance, Coding, Reliability, and Their Data Processing," Morgan Kaufmann Publ., 2021.

9. Other remarks

Additional remarks, comments, (e.g., language of the course)

Language of the course: English or Polish (depending on the audience)