Cyber-physical Systems Institute			Semester 3. of the curriculum 2025-26-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
High Availability Embedded Systems	NKXHA1EMNF	4	full-time	2	0	1
Responsible person for the subject: Prof. Dr. MOLNÁR András			Classification: Professor			
Subject lecturer(s): Zsolt BRINGYE						
Prerequisites:						
Way of the assessment:	mid-term grade					

Course description	
Goal:	Students will gain a comprehensive understanding of the expected reliability and failure rates of complex systems. They will be able to design systems where availability is critical and to operate redundant systems. Understand the advantages and disadvantages of redundancy. They will be able to propose the most advantageous redundant system in the design phase of complex systems, based on economic, operational and reliability criteria.
Course description:	Service, concept of minimum service. Majority redundancy. Mass, volume consumption issues for majority redundant systems. Redundant systems. Design of voting, selecting circuits. Redundant systems based on quality characteristics. High reliability systems implemented by master-slave systems. Nature and probability of failure of components. Probability of failure of complex systems, estimation of their life expectancy.

Lecture schedule	
Education week	Topic
1.	Basic concepts, formulation of reliability targets, definition of minimum service.
2.	Fault detection, locating faults within the system, detecting faults.
3.	Case studies of accidents caused by faults, analysing them, drawing conclusions.
4.	Majority redundant systems, voting circuits, weight, consumption, size problems.
5.	Redundant systems.
6.	Redundant systems based on quality characteristics.
7.	Hybrid (Master-Slave) redundant systems.
8.	Probability of failure of complex systems (parallel and series connected units). Lifetime of complex systems, failure probabilities and characteristics of specific periods of their lifetime.
9.	Battery packs, reliability of point series/parallel systems, failure modes and their probability of occurrence.
10.	Specific cases where the duplication of building blocks of systems has a safety reducing effect.
11.	Calculations to determine the availability of real systems.
12.	Redundant systems demonstrated by practical simulations (examples of physical implementation).
13.	Midterm exam
14.	Midterm exam (replacement)
Mid-term requirements	

Conditions for obtaining a mid-term grade/signature	Pass at least 51% of the midterm exam

Assessment schedule	
Education week	Topic
13.	Midterm exam from lecture and lab
14.	Midterm exam from lecture and lab (replacement)

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)
0% - 59%: fail (1) 60% - 69%: pass (2) 70% - 79%: satisfactory (3) 80% - 89%: good (4) 90% - 100%: excellent (5)

Type of the replacement	
Type of the replacement of written test/mid-term grade/signature	In the case if the mid-term test does not reach 50%, the student can replace the test in the form of re-take test in the 14th week. Replacement of the mid-term mark: once in the first 10 working days of the examination period.

Type of the exam (to be filled out only for subjects with exams)
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Calculation of the exam mark (to be filled only for subjects with exams)
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Final grade calculation methods:

References	
Obligatory:	Moodle system
Recommended:	
Other references:	