Cyber-physical Systems Institute			Semester 5 of the curriculum 2025-26-1			
Name of the subject:	Code of the subject:	Credits:	Weekly hours:			
				lec	sem	lab
Cloud Computing Services	NKXFS1EBNF	5	full-time	2	0	2
Responsible person for the subject: Róbert Lovas, PhD, habil			Classification: associate professor			
Subject lecturer(s): Attila Csaba Marosi, PhD; Krisztián Póra						
Prerequisites:	NKXOR1EBNF	Operating systems				
Way of the assessment:	Midterm grade					

Course description	
Goal:	The course aims to introduce the operation, architecture, and service models (IaaS/PaaS/SaaS) of cloud computing systems, as well as to acquire the basic theoretical and practical knowledge of public, private, and hybrid cloud platforms from both the user and operator perspectives. Students will learn about container-based technologies and their orchestration solutions, as well as distributed databases and design patterns related to modern cloud-based architectures (e.g., scalability, high availability, data processing, and observability). Based primarily on open-source solutions, the creation and operation of a private cloud providing infrastructure services will also be presented step by step.
Course description:	Building, operation, and general use of the OpenNebula private cloud solution. Cloud orchestration, management of different cloud objects, applications, and the use of Docker container technology and Docker Swarm cluster. Creating distributed NoSQL databases on a container basis. Getting to know the different service models of cloud computing systems (IaaS/PaaS/SaaS). Presentation of different cloud-based architecture design patterns that show the modern challenges and solutions of scalability, high availability, static and dynamic data management, data processing and event processing, search and analytical systems, as well as observability.

Lecture schedule	
Education week	Topic
1.	Lec: Cloud and software models Lab: Introduction to cloud services
2.	Lec: IaaS: APIs and development tools Lab: Docker I: Basics of container technology
3.	Lec: PaaS and SaaS: APIs and development tools Lab: Docker II: Advanced container technology
4.	Lec: OpenNebula: Open-source cloud and Edge computing platform Lab: Docker III: Advanced container technologies
5.	Lec: Design patterns I: Scalability Lab: Kubernetes: Container orchestration
6.	Lec: Design patterns II: High availability Lab: OpenNebula I: General usage
7.	Lec: Design patterns III: Static and dynamic data management Lab: OpenNebula II: General administration
8.	Lec: Design patterns IV: Databases Lab: MinIO: S3 compatible storage

9.	Lec: Design patterns V: Data processing Lab: Cassandra: Distributed column-oriented NoSQL database
10.	Lec: Design patterns VI: Event processing Lab: Cloud orchestration solutions
11.	Lec: Design patterns VII: Search and analytics Lab: Configuration management
12.	Lec: Design patterns VIII: Observability Lab: Semester project presentation I
13.	Lec: Midterm test Lab: Semester project presentation II
14.	Lec: Retake the midterm test Lab: Retake semester project presentation

Mid-term requirements

Conditions for obtaining a mid-term grade/signature	Attendance at classes in accordance with the regulations of HKR. Midterm test written with at least 50%. Successfully presented the midterm project.

Assessment schedule

Education week	Topic
13	Midterm
14	Midterm replacement

Method used to calculate the *mid-term grade* (to be filled out only for subjects with mid-term grades)

The in-semester grade is determined by the points achieved in the midterm test and the result of the semester project.

Type of the replacement

Type of the replacement of the written test/mid-term grade/signature	According to HKR, within one of the first 10 working days of the exam period, the signature can be replaced against a replacement fee.

Type of the exam (to be filled out only for subjects with exams)

Calculation of the exam mark (to be filled only for subjects with exams)

Final grade calculation methods:

The final grade will be calculated using the following scale:

Achieved result	Grade
87% - 100%	excellent (5)
75% - 86%	good (4)
64% - 74%	satisfactory (3)
51% - 63%	pass (2)
0 - 50 %	failed (1)

References

Obligatory:	Materials published in Moodle. B. A. Sosinsky, Cloud computing bible. Wiley, 2011, ISBN: 978-0-470-90356-8
Recommended:	B. Wilder: Cloud architecture patterns, O'Reilly, 2012, ISBN: 978-1-4493-1977-9

	M. Young, Implementing cloud design patterns for AWS: create highly efficient design patterns for scalability, redundancy, and high availability in AWS Cloud. Birmingham, UK: Packt Publishing, 2015, ISBN: 978-1-78217-735-7 A. Mouat, Using docker. Beijing: O'Reilly Media, Inc., 2016, ISBN: 978-1-4919-1592-9 Tyler Akidau, Slava Chernyak, and Reuven Lax. 2018. Streaming Systems: The What, Where, When, and How of Large-Scale Data Processing (1st. ed.). O'Reilly Media, Inc.
Other references:	The materials presented in class will become available on the Moodle page after lectures.