

SYLLABUS

1. Data about the program of study

1.1 Institution	The Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Automation and Computer Science
1.3 Department	Computer Science
1.4 Field of study	Computer Science and Information Technology
1.5 Cycle of study	Master
1.6 Program of study/Qualification	Data Science / Master
1.7 Form of education	Full time
1.8 Subject code	13.

2. Data about the subject

2.1 Subject name	Blockchain				
2.2 Course responsible/lecturer	Prof. dr. eng. Tudor Cioara - Tudor.Cioara@cs.utcluj.ro Prof. dr. eng. Ionuț Anghel - Ionut.Anghel@cs.utcluj.ro				
2.3 Teachers in charge of seminars/ laboratory/ project	Prof. dr. eng. Tudor Cioara - Tudor.Cioara@cs.utcluj.ro Prof. dr. eng. Ionuț Anghel - Ionut.Anghel@cs.utcluj.ro				
2.4 Year of study	II	2.5 Semester	1	2.6 Type of assessment (E - exam, C - colloquium, V - verification)	E
2.7 Subject category	DA – de aprofundare, DS – de sinteza, DC – complementară				DS
	DI – Impusă, DOp – opțională, DFac – facultativă				DI

3. Estimated total time

3.1 Number of hours per week	2	of which:	Curs	1	Seminars	1	Laboratory	-	Project	-
3.2 Number of hours per semester	28	of which:	Curs	14	Seminars	14	Laboratory	-	Project	-
3.3 Individual study:										
(a) Manual, lecture material and notes, bibliography										25
(b) Supplementary study in the library, online and in the field										25
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										19
(d) Tutoring										-
(e) Exams and tests										3
(f) Other activities:										-
3.4 Total hours of individual study (suma (3.3(a)...3.3(f)))							72			
3.5 Total hours per semester (3.2+3.4)							100			
3.6 Number of credit points							4			

4. Pre-requisites (where appropriate)

4.1 Curriculum	Distributed Systems
4.2 Competence	Specification, modelling, analysis, critical evaluation, design, implementation and validation of complex distributed systems; Concepts, techniques, methods and algorithms for: concurrency control, agreement, coordination and consensus, distributed transactions, failure tolerance, peer to peer (P2P).

5. Requirements (where appropriate)

5.1. For the course	Computers, software specific tools, MS Teams platform for online teaching, Course website
5.2. For the applications	Computers, software specific tools, MS Teams platform for online teaching, Course website

6. Specific competence

6.1 Professional competences	2. Development of advanced techniques, methods and methodologies in the domains of software design, programming systems and environments and their applications. 3. Innovative design of artificial intelligence and computer vision systems and related software and hardware using the specific tools. 5. Creative pooling of multidisciplinary knowledge in the field of computers and information technology for research, design, optimization, implementation and testing of theories, algorithms and original methods specific to artificial intelligence and computer vision systems.
6.2 Cross competences	3. Exercising the skill of continuous self-education and demonstrating critical, innovative and research abilities.

7. Discipline objective

7.1 General objective	The main objective of this discipline is to introduce concepts of blockchain technology and other types of distributed ledger implementations. These will be presented both from the theoretical perspective and from the practical point of view of how they are used to implement decentralized applications in different areas of applicability (e.g. financial, energy, management of distribution flows, medical, etc.). Thus, the aim is to ensure the necessary technical knowledge for the critical evaluation of existing decentralized applications as well as the development and integration of new solutions and applications using blockchain technology.
7.2 Specific objectives	To achieve the general objective, students will study concepts of blockchain technology, and will deepen issues related to scalability, consensus, integration with existing business models, etc. Different use cases and decentralized applications will be critically analysed aiming to understand how the fundamental implementation problems brought by decentralized can be solved.

8. Contents

8.1 Lectures	Hours	Teaching methods	Notes
Introduction, elements of course organization and basic concepts of blockchain technology	1	Blackboard, video projector presentation and/or online presentations using MS Teams platform. Discussions	N/A
Distributed digital ledgers and Bitcoin	1		
Smart contracts and decentralized applications	1		
Scalability problems and solutions	1		
Distributed consensus- PoW	1		
Distributed consensus– PoS, PoA	1		
Permissioned systems	1		
Blockchain and IoT	1		
Blockchain and machine learning	1		
Protection of personal data and blockchain	1		
Decentralization of stock exchanges	1		
P2P energy trading	1		
Decentralized management of distribution flows	1		
Blockchain applications in healthcare	1		
Bibliography			
1. Blockchain-based decentralized technologies for IoT systems, asset markets and smart grids, Claudia Daniela Antal, Ioan Salomie, Cluj-Napoca : U.T. Press, 2021 978-606-737-504-6			
2. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, ISBN-10: 1449374042, 2014.			
3. Course website			
8.2 Applications – Seminars	Hours	Teaching methods	Notes
Presentation of seminar activity	1		N/A

Configure and Start Ethereum node on private network	1	Blackboard presentations, application presentation, thematic papers developed as a result of bibliography research, presentation with the video projector, face-to-face discussions and / or in the online environment using the MS Teams platform	
Configure and Start Ethereum node on a test network	1		
Interact with the Ethereum Node	1		
Setup a third-party wallet -MetaMask	1		
Create a React application that connects to the MetaMask wallet	2		
Create an Auction SC & deploy it	2		
Integrate a NFT in your auction solution	2		
Evaluating a decentralized application using Ethereum	3		
Bibliography			
1. Building Blockchain-based decentralized applications: A practical guide, Claudia Daniela Antal, UTPRESS 2021, ISBN 978-606-737-538-1			
2. Course website			

9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

This discipline aims to develop and complement the concepts and skills acquired during undergraduate studies, proposing to study advanced concepts of decentralization, distributed ledgers and how to use blockchain technology to implement decentralized applications in different fields. These types of applications are becoming increasingly present both in the research area and in the commercial field.

10. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Ability to propose solutions to specific problems in the development of decentralized applications. Presence, (inter)activity during classes.	Face-to-face or online written exam using MS Teams platform	50%
Seminar			
Laboratory	Knowledge of existing technologies in the field in the development of decentralized applications. Presence, (inter)activity during classes.	Face-to-face and/or online assessment during the semester using the MS Teams platform	50%
Project			
Minimum standard of performance:			
Understanding the concepts in the studied field and demonstrating the ability to use the new technologies studied for the development of decentralized applications.			
Final grade: 50% (laboratory) + 50% (exam)			
Conditions for participation in the final exam: Laboratory Note ≥ 5 ; Elaboration of a Research Report and its presentation.			
Passing conditions: Final exam grade ≥ 5			

Date of filling in: 26.02.2025	Responsible	Title First name Last name	Signature
	Course	Prof.dr.eng. Tudor CIOARA	
		Prof.dr.eng. Ionuț ANGHEL	
	Applications	Prof.dr.eng. Tudor CIOARA	
		Prof.dr.eng. Ionuț ANGHEL	

Date of approval in the department

Head of department,
Prof.dr.eng. Rodica Potolea

Date of approval in the Faculty Council

Dean,
Prof.dr.eng. Vlad Mureșan