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

2. Data about the subject

2.1 Subject name	***Blockchain***			Subject code	**13.00**
2.2 Course responsible / lecturer	Prof. dr. eng. Tudor Cioara - Tudor.Cioara@cs.utcluj.ro				
2.3 Teachers in charge of seminars / Laboratory / project	Prof. dr. eng. Tudor Cioara - Tudor.Cioara@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	Formative category: DA – advanced, DS – speciality, DC – complementary				DA
	Optionality: DI – imposed, DO – optional (alternative), DF – optional (free choice)				DI

3. Estimated total time

3.1 Number of hours per week	2	of which:	Course	1	Seminars	1	Laboratory	-	Project	-
3.2 Number of hours per semester	28	of which:	Course	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 (sum (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	Projector, Computer, Whiteboard, Internet
5.2. For the applications	Projector, Computer, Whiteboard, Internet

6. Specific competence

6.1 Professional competences	analyse decentralised applications create data models define software architecture design process for blockchain-based systems develop blockchain innovative architectures develop software prototype evaluate blockchain architectures explain blockchain implications explain distributed ledger technologies principles identify blockchain innovation opportunities implement smart contracts interpret technical requirements manage cloud data and storage outline blockchain-based identity management perform scientific research provide technical documentation recognise blockchain application areas recognise blockchain risks use data processing techniques use software libraries
6.2 Cross competences	The graduate: • develop an analytical approach • taking a proactive approach • developing strategies to solve problems • being open minded

7. Expected Learning Outcomes

Knowledge	The student has knowledge of: • blockchain • blockchain application areas • blockchain applications • blockchain application security principles • blockchain architecture • blockchain components • blockchain consensus mechanisms • blockchain design patterns • blockchain history • blockchain mining principles • blockchain openness • blockchain platforms • blockchain terminology • blockchain-based business models • blockchain-based services regulation • decentralised identifiers • decentralized application frameworks • digital identity management • distributed ledger technologies • consensus protocols • distributed ledger technology vulnerabilities • smart contracts • smart contract programming languages • cryptocurrency

Skills	The student is able to: • analyse decentralised applications • design processes for blockchain-based systems • develop innovative blockchain architectures • evaluate blockchain architectures • explain blockchain implications • explain the principles of distributed ledger technologies • identify innovation opportunities in blockchain • implement smart contracts • interpret technical requirements • outline blockchain-based identity management • recognise blockchain application areas • recognise blockchain-related risks • use software libraries
Responsibilities and autonomy	The student has the ability to work independently in order to: • develop an analytical approach • take a proactive approach • develop strategies to solve problems • be open minded

8. Discipline objective (as results from the *key competences gained*)

8.1 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.
8.2 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.

9. Contents

9.1 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	
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

9.2 Applications - Seminars/Laboratory/Project	Hours	Teaching methods	Notes
Presentation of seminar activity	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 private network	1		
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

- Building Blockchain-based decentralized applications: A practical guide, Claudia Daniela Antal, UTPRESS 2021, ISBN 978-606-737-538-1
- Course website

**Se vor preciza, după caz: tematica seminariilor, lucrările de laborator, tematica și etapele proiectului.*

10. 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.

11. 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	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%
Laboratory			
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: 01.09.2025	**Responsible**	**Title First name Last name**	**Signature**
	Course	Prof.dr.eng. Tudor CIOARA	
	Applications	Prof.dr.eng. Tudor CIOARA	

Date of approval in the department 17.09.2025	Head of department, Prof.dr.eng. Rodica Potolea
Date of approval in the Faculty Council 19.09.2025	Dean, Prof.dr.eng. Vlad Mureșan