

## COURSE OUTLINE

### (1) GENERAL

<b>SCHOOL</b>	Social Sciences		
<b>ACADEMIC UNIT</b>	Department of Cultural Technology and Communication		
<b>LEVEL OF STUDIES</b>	Postgraduate Studies		
<b>COURSE CODE</b>	UA-TC2	<b>SEMESTER</b>	2
<b>COURSE TITLE</b>	Blockchain Technologies for Circular Ecosystems		
<b>INDEPENDENT TEACHING ACTIVITIES</b> <i>if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, state the weekly teaching hours and the total credits</i>	<b>WEEKLY TEACHING HOURS</b>	<b>CREDITS</b>	
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail in section (4).</i>	3	6	
<b>COURSE TYPE</b> <i>general background, special background, specialization, general education, skills development</i>	specialised (technical)	general	knowledge, skills development
<b>PREREQUISITE COURSES</b>	No		
<b>LANGUAGE OF INSTRUCTION AND OF ASSESSMENT</b>	English		
<b>MODE OF TEACHING</b> <i>in-person (%) synchronous distance learning (%) asynchronous distance learning (%) (In the case of synchronous distance learning, the total weekly duration of teaching is recorded)</i>	The course is delivered exclusively through synchronous distance learning.  Each weekly lecture lasts 180 minutes.		
<b>AVAILABILITY TO ERASMUS STUDENTS</b>	No		
<b>COURSE WEBSITE (URL)</b>	TBA		

### (2) LEARNING OUTCOMES

<p><b>Learning Outcomes</b></p> <p><i>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</i></p> <p><i>Consult Appendix A</i></p> <ul style="list-style-type: none"> <li>• <i>Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area</i></li> <li>• <i>Descriptors for Levels 6, 7 &amp; 8 of the European Qualifications Framework for Lifelong Learning and Appendix B</i></li> <li>• <i>Brief Guide for drafting Learning Outcomes</i></li> </ul> <p>After the successful completion of the course, the student will be able to:</p> <p>In terms of knowledge:</p> <ul style="list-style-type: none"> <li>• Critically evaluate blockchain architectures, consensus mechanisms, and smart-contract principles, demonstrating advanced understanding of their application to circular economy ecosystems.</li> <li>• Analyse major blockchain platforms and explain their suitability for transparency, traceability, and decentralisation requirements in circular value chains.</li> <li>• Demonstrate advanced knowledge of smart-contract languages, including design patterns, security vulnerabilities, and verification techniques.</li> </ul>
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- Synthesise the role of blockchain in enabling trusted circular business models (e.g., product-as-a-service, reverse logistics, repair ecosystems).
- Explain how digital identity, decentralised storage, and cryptographic tools support data integrity, privacy, and resilience in circular ecosystems.
- Evaluate organisational and technical barriers to blockchain adoption (cost, digital literacy, governance, interoperability) and propose strategies to overcome them.

In terms of skills:

- Conceptualise secure, well-structured smart contracts aligned with circular-economy requirements and best-practice patterns.
- Design foundational decentralised applications that interact with blockchain clients and circular-economy data layers.
- Integrate blockchain, identity management, and decentralised storage solutions to support material traceability and compliance across product lifecycles.
- Apply blockchain-enabled tools to model and optimise circular supply-chain processes in sectors such as agri-food, energy, and textiles.

In terms of responsibility and autonomy:

- Drive strategic decisions on blockchain adoption for circular transformation, balancing technical feasibility, environmental impact, compliance, and stakeholder value.
- Take responsibility for ensuring ethical, secure, and responsible smart-contract and DApp development, including risk mitigation and auditability.
- Manage cross-functional blockchain deployment projects, coordinating technical, organisational, and regulatory requirements across diverse teams.
- Exercise advanced judgement when selecting blockchain architectures, interoperability standards, and governance models for complex and unpredictable circular-economy scenarios.
- Coordinate the development of end-to-end blockchain solutions, including components such as identity, storage, contracts and traceability, that generate long-term circular value.

### General Competences

*Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and are stated below), at which of the following does the course aim?*

*Search, analysis and synthesis of data and information, with the use of the necessary technology*  
*Adaptability to new situations*  
*Decision-making*  
*Working independently*  
*Team work*  
*Working in an international environment*  
*Working in an interdisciplinary environment*  
*Production of new research ideas*

*Project planning and management*  
*Respect for difference and multiculturalism*  
*Respect for the natural environment*  
*Showing social, professional and ethical responsibility and sensitivity to gender issues*  
*Criticism and self-criticism*  
*Production of free, creative and inductive thinking*  
 .....  
*Other...*  
 .....

The current course will enable students to acquire the following competences:

- Search for, analysis and synthesis of data and information, with the use of the necessary technology, as UA-TC2 heavily involves analysing blockchain architectures, smart contracts, decentralised storage, identity systems, and interoperability standards.
- Strategic and innovative thinking for managerial problem-solving, as the learning outcomes require selecting appropriate blockchain architectures, designing blockchain-enabled circular business models, and driving digital transformation strategies.
- Working in an interdisciplinary environment as UA-TC2 requires combining computer science (blockchain, smart contracts), sustainability and circular-economy principles, regulatory and governance structures, and business model innovation.
- Ethical, responsible, and sustainable decision-making in business contexts, as lectures address environmental impacts of blockchain, security risks, data protection, trust, transparency, and governance of decentralised systems.

- Leadership and team coordination in complex or multicultural environments, as the course prepares students to lead blockchain implementation projects, coordinate interdisciplinary teams, and manage stakeholder trust across supply chains.

### (3) COURSE SYLLABUS

**UA-TC2: Blockchain Technologies for Circular Ecosystems** provides an in-depth exploration of how blockchain technology supports transparency, traceability, and decentralization within circular business models. Students will learn how blockchain is applied in supply chain management, ensuring compliance with sustainability standards and best practices and facilitating material tracking across product lifecycles.

The course consists of 13 lectures, as presented below:

1. **Introduction to Blockchain Technologies (Instructor: UMA).** This lecture provides an overview of blockchain concepts, goals, benefits, challenges, and security approaches. It also discusses the environmental impact of blockchain systems.
2. **Main blockchain platforms (Instructor: UMA).** This lecture offers a technical overview of how core blockchain principles are implemented in major platforms such as Bitcoin, Ethereum, and Hyperledger Fabric. Students compare architectural differences and their relevance for circular-economy applications.
3. **Understanding solidity smart contracts (Instructor: UMA).** This lecture introduces the fundamentals of Solidity smart contracts, including basic data types and modifiers. Students work through incremental examples to understand contract logic.
4. **Best practices for solidity smart contracts (Instructor: UMA).** This lecture presents common Solidity design patterns, security vulnerabilities, and testing methodologies. Students learn how to write safer, more robust contracts aligned with industry standards.
5. **Decentralised applications: interfacing ethereum clients (Instructor: UMA).** This lecture introduces decentralized applications (DApps), focusing on interaction with Ethereum client APIs. Students develop foundational DApps to understand basic blockchain integration.
6. **Decentralised applications: smart contracts interaction (Instructor: UMA).** This lecture covers advanced DApp development and demonstrates how decentralised applications interact with smart contracts. Students explore end-to-end technical flows between interfaces and contract layers.
7. **Challenges and barriers to blockchain adoption in the circular economy (Instructor: UAEGEAN).** This lecture examines cost, integration, governance, and digital-literacy barriers to blockchain adoption in circular value chains. Students analyse why organisations struggle with implementation and how these challenges can be overcome.
8. **Designing circular business models enabled by blockchain (Instructor: CEF).** This lecture introduces circular business model patterns and shows how blockchain supports innovation across reuse, repair, and recycling strategies. Real-world platforms illustrate how blockchain enables new value creation.
9. **The role of blockchain in building trust in circular supply chains (Instructor: CEF).** This lecture explores how blockchain strengthens trust through transparency and verifiable data sharing. Case examples cover ethical sourcing, conflict-free minerals, fair trade, and the social barriers that blockchain helps address.
10. **Digital identity management and blockchain storage (Instructor: UiO).** This lecture introduces digital identity in contexts such as e-health and explains how decentralised storage technologies have evolved from P2P systems to advanced distributed networks. It highlights immutability, security, and scalability considerations.
11. **Blockchain: case studies in the agri-food sector for circularity (Instructor: WU).** This lecture presents blockchain applications in the agri-food sector using hands-on case studies. Students work with example datasets and distributed-system tools to analyse circularity opportunities.

12. **Build a Blockchain (Instructor: ZELUS).** In this workshop, students receive a use case and build an end-to-end blockchain system using available frameworks. The session emphasises practical implementation and architectural understanding.
13. **Blockchain: case studies in the energy and textile industries (Instructor: ZELUS).** This lecture examines blockchain applications in energy and textile sectors to support circular-economy ecosystems. It extends the workshop by showing full implementation paths and industry-specific deployment challenges.

#### (4) TEACHING AND LEARNING METHODS - ASSESSMENT

<b>MODE OF TEACHING</b> <i>Face-to-face, distance learning, etc.</i>	Distance Learning	
<b>MODE AND FREQUENCY OF COMMUNICATION WITH THE STUDENTS</b>	Synchronous distance communication on a weekly basis, asynchronous on a daily basis through LMS platform	
<b>ENSURING THE MODE OF COMMUNICATION AMONG STUDENTS</b> <i>Team assignments and discussions, collaborative learning platforms with the use of AI, video conference, QA sessions, κ.α.</i>	Weekly assignments, discussions through dedicated discussion forum, dedicated space per module on the learning platform, schedule video conference meetings through MS Teams, dedicated QA sessions per module	
<b>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</b> <i>Use of ICT in teaching, in laboratory training, in the communication with students</i>	Use of ICT in Teaching, Communication with students Online Platforms will be used for teaching, tutorials, students' guidance, students' self-assessment and support on group projects	
<b>TECHNOLOGICAL EQUIPMENT REQUIREMENTS</b>	PC /laptop for video conference meeting	
<b>PLAGIARISM POLICY/ PLAGIARISM DETECTION TOOLS</b>	Gradescope, Turnitin	
<b>ARTIFICIAL INTELLIGENCE POLICY</b> <i>(1) The use of Artificial Intelligence is prohibited in all circumstances</i> <i>(2) The use of Artificial Intelligence is allowed only with the permission of the instructor</i> <i>(3) The use of Artificial Intelligence is allowed only with an explicit reference to the literature</i> <i>(4) Students are free to use Artificial Intelligence</i>	The use of Artificial Intelligence is allowed only with an explicit reference to the literature. Additionally, students are free to use AI provided by the master programmes for contacting stimulations, practicing purposes, etc.	
<b>ORGANISATION OF TEACHING</b> <i>The mode and methods of teaching are described in detail.</i> <i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, work placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artworks, etc.</i>  <i>The student's study hours for each learning activity are stated, as well as the hours of independent study, according to the principles of the ECTS.</i>	<b>Activity</b>	<b>Semester workload</b>
	Lectures	39
	Participation in forum discussions	16,5
	Study, analysis of bibliography and supplementary consolidation activities	73,5
	Self-Assessment Evaluations	21
	<b>Course total</b>	<b>150</b>
<b>STUDENT ASSESSMENT</b> <i>Description of the assessment method</i>  <i>Language of assessment, methods of assessment, formative or summative assessment, multiple choice questions test, short answer questions, essay questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory assignment, clinical examination of patient, art interpretation, other</i>	Students will be evaluated following multiple-choice, short-answer, and open-ended questions.  The assessment formula is the following:  Self-Assessment Evaluations: 50% Final Assessment: 50%	

*Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*

## (5) RECOMMENDED BIBLIOGRAPHY

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- [2] I. Bashir, *Mastering Blockchain: Inner Workings of Blockchain, From Cryptography and Decentralized Identities to DeFi, NFTs and Web3*, 4th ed. Birmingham, U.K.: Packt Publishing, 2023. ISBN: 978-1803241067.
- [3] C. Parisi et al., *Mastering Ethereum*, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2025. ISBN: 978-1098168421.
- [4] A. M. Antonopoulos and D. A. Harding, *Mastering Bitcoin: Programming the Open Blockchain*, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2023. ISBN: 978-1098150099.
- [5] A. M. Antonopoulos, *Mastering Ethereum*. [Online]. Available: <https://aantonop.com/books/mastering-ethereum/>
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