Euncet Business School

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UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

BLOCKCHAIN AND DECENTRALIZED FINANCE TEACHING GUIDE 2025-26

GENERAL DATA

Name:	Blockchain and Decentralized Finance
Code:	
Course:	2025-26
Titration:	Master's Degree in Financial Innovation and Fintech
Number of credits (ECTS):	5
Location in the curriculum:	1st year, 2nd. Semester
Department:	
Head of department:	
Date of last revision:	April 2025
Teaching staff:	Arnau Via (Mathematician, MilGauss and PeerSyst), Eric Garcia (Computer Scientist, MoraBanc Digital Assets), Carlos Salinas (Economics, MoraBanc Digital Assets Director)

1. OVERVIEW

This subject provides a rigorous understanding of the impact of blockchain technology and decentralized finance (DeFi) on the financial system. The technical foundations of distributed networks – including cryptography, consensus and smart contracts – and their application in services such as decentralized exchanges, lending, staking or tokenization of assets will be studied.

The course analyzes the cryptoasset ecosystem from a technological, economic, and regulatory perspective, encompassing networks such as Bitcoin and Ethereum, scalability solutions (L2, ZK-rollups), stablecoins, CBDCs, and decentralized governance models (DAOs).

Emerging regulatory frameworks (MiCA, Travel Rule, eIDAS 2) will also be addressed, as well as the challenges associated with custody, regulatory compliance and investor protection. Likewise, new Web3 business models and their impact on the digital economy will be explored.

The subject combines theory and practice through the use of real tools such as wallets and DeFi platforms, financial simulations and analysis of current cases. The student will acquire a strategic and transversal vision of the role of blockchain in the transformation of the financial system.

2. OBJECTIVES

- Understand the technical and economic underpinnings of blockchain networks, including what defines a valid transaction, how consensus is reached, what a fork entails, and what vulnerabilities can compromise the security and stability of the network.

- Analyze how decentralized architectures allow the execution of peer-to-peer transactions, promoting operational resilience, reduction of intermediaries and efficiency in financial markets.

- Study the main blockchain platforms (Bitcoin, Ethereum, L2) and their applicability in decentralized financial services.

- Identify and categorize the different types of tokens and their role within digital economic models and asset tokenization processes.

- Assess the operation, opportunities, and risks of DeFi services (exchanges, lending, derivatives, staking) from a financial and technological perspective.

- Explore the legal and regulatory implications of digital assets, with a focus on MiCA, AML/KYC, Travel Rule, and investor protection.

- Learn about the new business models and governance in Web3, and their impact on financial disintermediation and the digital economy.

3. LEARNING OUTCOMES

At the end of the course, the student will be able to:

K7.1: Distinguish the fundamentals of blockchain methodology, types of platforms, and smart contracts.

K7.2: Distinguish the use cases of blockchain technology, its platforms, applications, risks, and benefits.

S1.1: Communicate effectively orally, in writing and graphically with other people about learning, thinking and decision-making, and participate in debates, making use of interpersonal skills, such as active listening and empathy, which favour teamwork.

S2.1: Develop the capacity to contribute to innovation in new or existing business institutions and organizations, through participation in creative projects and have the

ability to apply skills and knowledge on technology-based business sales, organization and development.

S3.1: Understand advanced digital technologies, so that they can be applied with a critical perspective, in diverse contexts, in academic, professional, social or personal situations.

S10.1. Differentiate the different use cases of blockchain in banking.

S10.2: Evaluate the blockchain protocol, differentiate the different types of platforms as well as the sustainability and governance of the system.

C1.1: Integrate the values of sustainability, understanding the complexity of systems, in order to undertake or promote actions that restore and maintain the health of ecosystems and improve justice, generating diverse visions for sustainable futures.

C2.1: Identify and analyse problems that require autonomous, informed and reasoned decision-making, in order to act with social responsibility, in accordance with ethical values and principles.

C3.1: Develop the capacity to assess gender and gender inequalities and to design solutions.

C10.1: Apply fundamentals of blockchain technology in the implementation of projects related to cryptoassets through different types of platforms.

C10.2: Apply the different use cases of blockchain technology in finance and banking.

We can highlight:

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- Explain how economic incentives underpin consensus mechanisms in blockchain networks and how they define what is considered a valid transaction.
- Identify and analyze the different types of forks (hard/soft) and their relevance for network governance, evolution, and stability.
- Describe the main attack vectors on blockchain networks (double-spending, 51%, MEV, etc.) and evaluate mitigation measures.
- Analyze how peer-to-peer transactions contribute to the efficiency and resilience of the financial system by reducing intermediaries.
- Compare the characteristics and applications of different blockchain networks (Bitcoin, Ethereum, L2) in concrete financial scenarios.
- Classify the different types of tokens and explain their functional and economic role in decentralized environments.

- Use DeFi platforms to execute basic financial operations and analyze their economic and technical implications.
- Critically assess regulatory and compliance risks in digital asset trading.
- Analyze decentralized models of organization (DAOs) and their transformative potential in economic and financial sectors.

4. CONTENTS

TOPIC 1. BLOCKCHAIN FUNDAMENTALS: CONSENSUS, INCENTIVES, AND SECURITY

Specific learning outcomes:

- Understand the technical fundamentals of a blockchain network: data structure, cryptography, and validation.
- Analyze different consensus mechanisms and the economic incentives that sustain them.
- Identify what constitutes a valid transaction, how a fork occurs, and what implications it has.
- Assess the main attack vectors and risks inherent in designing a decentralized network.

Contents:

1. Cryptography applied to blockchain: hash functions, digital signatures, Merkle trees.
2. Consensus mechanisms:
   2.1. Proof of Work (PoW): probabilistic security and mining.
   2.2. Proof of Stake (PoS): economic validation, staking, and penalties.
   2.3. Proof of Authority (PoA): validators identified in institutional and regulated networks.
   2.4. Other variants: BFT, dBFT, asynchronous consensus, and hybrid mechanisms.
3. Valid transactions and block inclusion process.
4. Incentives and economic design of consensus: commissions, rewards, sustainability.
5. Forks: types (hard/soft), causes, resolution and governance.
6. Attack vectors: 51%, double-spend, censorship, MEV, liquidity attacks.

7. The blockchain trilemma: security, decentralization, and scalability.

TOPIC 2: BLOCKCHAIN PLATFORMS AND SMART CONTRACTS

Specific learning outcomes:

- Compare different blockchain networks based on their architecture, performance, governance, and use cases.
- Understand how smart contracts work and their role in executing decentralized finance logic.
- Identify the main scalability solutions and their impact on the design of financial products.

Contents:

1. Bitcoin: economic model, limited scripting, security and value proposition as a digital reserve.
2. Ethereum: EVM, smart contracts, gas and standardization (ERC-20, ERC-721, ERC-4626...).
3. Scalability solutions: rollups (zk and optimistic), payment channels, sidechains, sharding.
4. ZK-rollups and privacy: efficiency, custody and selective anonymity.
5. Other relevant networks:
   5.1. XRP Ledger (XRPL): EVM-free architecture, federated consensus, focus on payments and institutional assets.
   5.2. Solana: high efficiency and throughput, parallel execution model (Sealevel).
   5.3. Avalanche, Polkadot, Cosmos: interoperability, subnets, and modularity.
6. Operational constraints: cost, speed, composability, fragmentation.

TOPIC 3: CRYPTOASSETS AND TOKENIZATION

Specific learning outcomes:

- Classify the different types of tokens and understand their economic functions.
- Understand the issuance and governance mechanisms that shape tokenized ecosystems.
- Analyze the role of stablecoins, CBDCs, and NFTs in the evolution of money and digital assets.

Contents:

1. Types of tokens: fungible, non-fungible, utility, governance, wrapped assets.
2. Issuance mechanisms: ICOs, IDOs, airdrops, token generation events.
3. Economic design of tokens (tokenomics): distribution, incentives, inflation, burning, bonding curves.
4. Stablecoins: algorithmic, collateralized, regulated models.
5. CBDCs: architecture, interoperability and institutional privacy.
6. NFTs and use cases beyond art: identity, ownership, tokenization of real assets.

TOPIC 4: DECENTRALIZED FINANCE (DeFi)

Specific learning outcomes:

- Apply the use of DeFi protocols for basic operations such as swapping, lending, or staking.
- Assess the economic, technological, and regulatory risks of DeFi infrastructure.
- Understand the logic of the decentralized market and its implications for financial efficiency.

Contents:

1. Wallets and custody: self-custody, institutional solutions, social recovery, MPC.
2. Decentralized exchanges (DEXs): operation, AMMs, impermanent loss, aggregators.
3. Lending and borrowing protocols: collateral, dynamic interest, settlements.
4. Staking: participation in validation, incentive models, slashing.
5. DeFi derivatives: perpetuals, decentralized options, synthetic futures.
6. Bridges and interoperability risks.
7. Liquidity providers, yield farming and return optimization strategies.

TOPIC 5: REGULATION, RISKS AND BUSINESS MODELS IN WEB3

Specific learning outcomes:

- Analyze the European regulatory framework and its impact on the development of blockchain-based products.

- Identify legal, technological, and governance risks in decentralized networks.
- Evaluate business models and decentralized organizational structures applicable to the financial environment.

Contents:

1. European regulations: MiCA, eIDAS 2, DLT Pilot Regime.
2. Regulatory Compliance: KYC/AML, Travel Rule, Investor Protection.
3. Legal and operational risks: liability, anonymity, oracles, exploits.
4. DAOs and on-chain governance: models, legal challenges, scalability of social consensus.
5. Web3 business models: value capture, sustainability, and monetization.
6. Institutional applications and hybrid models: use of PoA in private networks, institutional DeFi, integration with regulated custodians.

5. TEACHING AND LEARNING METHODOLOGY

Teaching is carried out through a series of face-to-face sessions, whose spirit is to combine theory and practice in a balanced way, complemented by a series of didactic materials (manual and presentation), exercises and cases for their resolution, provided online and with *feedback*, also online, using the program's own platform as a digital support.

The face-to-face activities will be carried out through:

- Presentation by the teacher of the practical application of the theoretical contents of the different topics of the subject. It is essential that the student reads beforehand (by the student) the reference manual for each topic that is available in the virtual classroom.
- Discussion of content.
- Application of concepts and methodologies to examples/case studies

Learning will be consolidated through the resolution of the exercises and/or cases that will be provided on the virtual campus of the subject.

6. EVALUATION

In accordance with the Bologna Plan, the model rewards the constant and continuous effort of students. 60% of the grade is obtained from the continuous evaluation of the directed activities and the remaining 40% from the final face-to-face exam. The final exam has two sittings.

The final grade of the subject (NF) will be calculated based on the following formula:

- **NF = Final Exam Grade x 40% + Continuous Evaluation Grade x 60%**
- The minimum grade of the final exam to calculate the NF will be 40 points out of 100.
- The subject is approved with an NF equal to or greater than 50 points out of 100.

Type of activity	Description	% Continuous evaluation	
Questionnaires:			**60%**
Questionnaire 1	Test Topic 1	20%	
Questionnaire 2	Test Topic 2	20%	
Questionnaire 3	Test Topic 3	20%	
Questionnaire 4	Test Topic 4	20%	
Questionnaire 5	Test Topic 5	20%	
Final examination			**40%**
	Final examination	100%	

7. BIBLIOGRAPHY

7.1. BASIC BIBLIOGRAPHY

- Buterin, V. et al. (Ethereum Foundation) – *Ethereum Documentation* (https://ethereum.org/en/developers/docs/).

  Official reference on smart contracts, EVM, and PoS consensus mechanisms.

- Narayanan, A. et al. (2016) – *Bitcoin and Cryptocurrency Technologies*. Princeton University Press.

  Excellent as a rigorous introduction to the technical fundamentals of blockchain and applied cryptography.

- Schär, F. (2021) – *Decentralized Finance: On Blockchain- and Smart Contract-Based Financial Markets*. *Federal Reserve Bank of St. Louis Review*.

  Widely cited academic article covering the principles and structures of DeFi.

- Singh, S. (1999) – *The Code Book: The Science of Secrecy from Ancient Egypt to Quantum Cryptography*. Fourth Estate.

A historical and accessible introduction to cryptography, from classical ciphers to modern systems. Ideal for understanding the conceptual foundations that underpin security in blockchain networks.

- XLP Ledger Dev Portal – *XRPL Documentation* (https://xrpl.org/).

  Official documentation of the XRP Ledger: architecture, consensus, assets and institutional use.

7.2 ADDITIONAL BIBLIOGRAPHY

- Antonopoulos, A. M.
  - Mastering Bitcoin (2017)
  - Mastering Ethereum (2019)

  Clear technical manuals, with a progressive and detailed approach.

- CoinGecko / DeFiLlama / Dune Analytics

  Up-to-date tools and portals for market analysis, volume, TVL, and participation in DeFi protocols.

- European Commission – MiCA Regulation (2023).

  Official text and comments on the EU Markets in Crypto-Assets Regulation.

- Gans, J. S. (2023) – The Future of the Wallet: How Digital Payments Are Changing Global Commerce. MIT Press.

  Review of the structural impact of new digital infrastructures on the financial system.

- Mougayar, W. (2016) – The Business Blockchain. Wiley.

  Strategic vision of blockchain's impact on business models and governance.

- OECD (2020) – The Tokenisation of Assets and Potential Implications for Financial Markets.

  White paper analyzing risks, benefits, and regulatory challenges of tokenization.

- Solana Docs – Solana Developer Documentation (https://docs.solana.com/).

Official documentation: parallel execution model, Rust programming, DeFi/NFT use cases.