UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Fintech

2627-2-F1602M012-F1602M012-2

Learning objectives

1. Knowledge and understanding

By the end of the course, students will have acquired a deep and structured knowledge of the theoretical principles underlying cryptocurrencies and distributed ledgers. In particular, they will be able to understand:

- The mathematical models and computational properties of symmetric and asymmetric cryptography (hash functions, digital signatures).
- The logical architecture of the Bitcoin protocol and the game theory underlying the Proof-of-Work (PoW) consensus mechanism.
- The economic paradigms governing market microstructure and price formation within decentralized financial markets (DeFi).

2. Applying knowledge and understanding

Students will be able to translate theoretical expertise into operational skills for analysis and evaluation, demonstrating the ability to:

- Critically analyze the algorithmic robustness and security protocols of a cryptographic system applied to DLTs.
- Quantitatively evaluate, through risk management metrics (e.g., volatility, dyn

amic correlations, VaR, Max Drawdown), the portfolio impact of incorporating cr ypto-assets or associated financial derivatives and ETFs into complex investmen t portfolios.

- Interpret liquidity and pricing dynamics in fragmented markets regulated by Aut omated Market Makers (AMMs).

3. Making judgements

The course fosters the development of independent and critical thinking. Students will be able to:

- Evaluate the structural trade-offs of decentralized systems (e.g., the blockcha in trilemma: scalability, security, and decentralization).

- Judge with scientific rigor the risk/return profile and economic sustainability of cryptocurrencies as an asset class, distinguishing between the intrinsic va lue of technological innovation and market speculative components.

- Identify and estimate the potential systemic, operational, and cryptographic ri sks inherent in blockchain protocols and decentralized markets.

4. Communication skills

Students will refine their ability to convey complex information and analyses to diverse audiences, learning to:

- Communicate the mathematical, computer science, and financial concepts that cha racterize the FinTech ecosystem clearly, fluidly, and with appropriate technica l and scientific language.

- Structure and present their arguments or the results of quantitative portfolio evaluations both in specialized contexts (e.g., risk management teams, executiv e reporting) and in broader institutional or public educational settings.

5. Learning skills

Given the highly evolutionary nature of the FinTech sector, the course provides the necessary methodological foundations to enable students to:

- Independently explore and study relevant scientific literature, technical white papers of new protocols, and industry regulatory updates.

- Develop a method for continuous self-directed learning to stay constantly updat ed on future technological developments in cryptography, blockchain, and decent ralized markets.

Contents

Cryptocurrencies, cryptography, decentralized markets.

Detailed program

Cryptographic Foundations and Distributed Ledgers.
Introduction to the FinTech paradigm: Disintermediation, centralization vs. decentralization, evolution of payment systems, and taxonomy of Distributed Ledger Technologies (DLTs).
Elements of Cryptography for Blockchain.
Cryptographic hash functions: Definition, core properties (collision resistance, determinism, avalanche effect), and the SHA-256 standard.
Asymmetric cryptography: Public and private key algorithms, key-pair mechanics, and digital signature schemes (ECDSA).
Architecture of distributed data structures: The concept of a block, the chain of blocks (Blockchain).

The Bitcoin Protocol and the Economics of Consensus
Anatomy of Bitcoin: Peer-to-Peer (P2P) network operations, protocol structure, the UTXO (Unspent Transaction Output) model, and the lifecycle of a transaction.
The double spending problem (Double Spending): Game theory applied to solving trust issues in the absence of a central authority.
Decentralized Consensus Algorithms: The Proof-of-Work (PoW) mechanism.
The role of Miners: Economic incentives (block rewards and transaction fees).

Microstructure and Pricing in Decentralized Markets
Cryptocurrencies as an Asset Class: Economic and financial characteristics, differences from fiat currencies, and token classification (Utility, Security, Stablecoins).
DeFi Ecosystem and Market Microstructure: Centralized Exchanges (CEX) vs. Decentralized Exchanges (DEX).
The price formation process in fragmented markets: Arbitrage and order book management. Automated Market Makers (AMM) mechanics

Prerequisites

No specific prerequisites.

Teaching methods

Lectures.

Approximately 70% of the teaching will be delivered through traditional lectures. The remaining 30% of the total

hours will be conducted in an interactive format, including ongoing assessments of students' understanding of the topics covered, practical applications with MATLAB, and the use of Bloomberg.

Assessment methods

Written exam with open questions. A mid-term exam is scheduled.

Textbooks and Reading Materials

Textbooks will be suggested during the lectures.

Slides of the lectures.

Semester

First term.

Teaching language

Italian

Sustainable Development Goals

INDUSTRY, INNOVATION AND INFRASTRUCTURE