COURSE DETAILS

"DECENTRALIZED APPLICATIONS AND BLOCKCHAIN"

SSD ING-INF/05 *

DEGREE PROGRAMME: CORSO DI LAUREA MAGISTRALE IN INGEGNERIA INFORMATICA

ACADEMIC YEAR: 2023/2024

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: GIUSEPPE ACETO
PHONE:
EMAIL: GIUSEPPE.ACETO@UNINA.IT

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE):
MODULE (IF APPLICABLE):
CHANNEL (IF APPLICABLE):
YEAR OF THE DEGREE PROGRAMME (I, II, III): I
SEMESTER (I, II):
CFU: 6

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "ORDINAMENTO")

No

PREREQUISITES (IF APPLICABLE)

Computer Networking, Computer Programming

LEARNING GOALS

The course aims to provide the skills for understanding the functioning of the main blockchain-based platforms (both public and permissioned) and for the development of smart contracts and decentralized applications (DApps).

The course also intends to provide the methodological tools to analyze and evaluate the set of technologies available for the implementation of DApps, to guide their design, development and adoption in different application contexts.

The course includes practical and laboratory classes functional to the development of a course project.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate knowledge and understanding of the problems arising and solutions available relating to the design and development of decentralized applications (DApps), with particular reference to blockchain-based architectures, the problem of consensus, and tools related to blockchains.
The student must also demonstrate knowledge and understanding of the concept of smart contracts, and the main languages for the programmability of blockchain-based architectures.

Applying knowledge and understanding

The student must demonstrate being able to design DApps taking into account the application context, the available technologies and their characteristics. They must also be able to develop simple DApps by effectively using the knowledge acquired regarding the programmability of blockchain-based architectures.

COURSE CONTENT/SYLLABUS

Part I - Background

Introduction and contextualization of cryptocurrencies, blockchain, smart contracts and decentralized applications.
Introduction to distributed systems, decentralized systems and the consensus problem. Distributed ledger technologies.
Fundamentals of cryptography: public key algorithms, digital signature, hashing, validation.
Consensus protocols: Proof of Work, Proof of Stake, Proof of Authority, other protocols.
Smart Contracts and Tokens.
Types of tokens, fungible and non-fungible (NFT).
Trust and communities: hard fork and soft fork.

Part II - Technologies

Blockchain Technologies: Bitcoin, Ethereum, IOTA and other major blockchains.
Scalability and consensus protocols; Layer 2 solutions: Lighting Network, Polygon.
Tools for using blockchain (wallet, chain explorer, gateway and API), off-chain systems, IPFS.
Lab #1: Use of test chains of selected blockchains

Part III - Programmability

Decentralized Applications on Blockchain (DApp).
DApp prototype development (smart contract + interface + off-chain systems).
Test-driven development of DApp.
DApps models and emerging standards.
Lab #2: Prototype implementation of DApp

Part IV - Challenges and perspectives

Security aspects related to DApps and smart contracts.
Network Security and Blockchain: Blockchain Threats and Blockchain-Based Solutions.
Blockchain privacy and blockchain interoperability (cross-chain technologies).
Performance measurement of blockchain-based technologies.
Integration of Artificial Intelligence and blockchain.
Applications of blockchain-based technologies in SDN, IoT, 5G/6G, eHealth contexts.
Decentralized Autonomous Organization (DAO).
Challenges and opportunities for the adoption and development of Blockchain and DApps.

READINGS/BIBLIOGRAPHY

- Lecture slides and notes
- Further teaching material provided by the teacher
- *Dannen, Chris. Introducing Ethereum and solidity. Vol. 1. Berkeley: Apress, 2017.*

TEACHING METHODS

The course will consist of:
a) lectures for approx. 70% of total hours;
b) laboratories and/or practical lessons for the remaining 30% of total hours.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	
only written	
only oral	X
project discussion	X
other	

In case of a written exam, questions refer to: (*)	**Multiple choice answers**	
	Open answers	
	Numerical exercises	

(*) multiple options are possible

The oral exam will include the presentation and discussion of a course project previously prepared by the student.

b) Evaluation pattern: