**SYLLABUS**

**1. Information regarding the programme**

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| 1.1 Higher education institution | **Babeş-Bolyai University** |
| 1.2 Faculty | **Faculty of Mathematics and Computer Science** |
| 1.3 Department | **Department of Computer Science** |
| 1.4 Field of study | **Computer Science** |
| 1.5 Study cycle | **Master** |
| 1.6 Study programme / Qualification | **Cyber Security** |

**2. Information regarding the discipline**

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|---|---|---|---|---|---|---|---|
| 2.1 Name of the discipline (en)<br>(ro) | | | **Blockchain Security**<br>**Securitatea în Blockchain** | | | | |
| 2.2 Course coordinator | | | **Assoc. Prof. Eng. Florin Craciun** | | | | |
| 2.3 Seminar coordinator | | | **Assoc. Prof. Eng. Florin Craciun** | | | | |
| 2.4. Year of study | **1** | 2.5 Semester | **2** | 2.6. Type of evaluation | **E** | 2.7 Type of discipline | **Optional** |
| 2.8 Code of the discipline | | **MME8197** | | | | | |

**3. Total estimated time** (hours/semester of didactic activities)

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|---|---|---|---|---|---|
| 3.1 Hours per week | 4 | Of which: 3.2 course | 2 | 3.3 seminar/laboratory | 1 sem + 1 project |
| 3.4 Total hours in the curriculum | 56 | Of which: 3.5 course | 28 | 3.6 seminar/laboratory | 28 |

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| Time allotment: | hours |
| Learning using manual, course support, bibliography, course notes | 35 |
| Additional documentation (in libraries, on electronic platforms, field documentation) | 25 |
| Preparation for seminars/labs, homework, papers, portfolios and essays | 45 |
| Tutorship | 5 |
| Evaluations | 9 |
| Other activities: ..... | - |

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| 3.7 Total individual study hours | 119 |
| 3.8 Total hours per semester | 175 |
| 3.9 Number of ECTS credits | 7 |

**4. Prerequisites** (if necessary)

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| 4.1. curriculum | · none |
| 4.2. competencies | · programming languages |

**5. Conditions** (if necessary)

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| 5.1. for the course | · video projector |
| 5.2. for the seminar /lab activities | · video projector |

**6. Specific competencies acquired**

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| **Professional competencies** | · C3.1 Identifying classes of problems and solving methods that are specific to computing systems<br>· C3.2 Using interdisciplinary knowledge, solution patterns and tools, making experiments and interpreting their results<br>· C3.3 Applying solution patterns using specific engineering tools and mehods<br>· C3.4 Comparatively and experimentaly evaluation of the alternative solutions for performance optimization<br>· C3.5 Developing and implementing information system solutions for concrete problems<br>· C4.1 Identifying and describing technologies, programming environments and various concepts that are specific to programming engineering<br>· C4.2 Explaining the role, interaction and operation patterns of software system components<br>· C4.3 Developying specifications and designing information systems using specific methods and tools<br>· C4.5 Developing, implementing and integrating software solutions |
| **Transversal competencies** | · CT1 Honorable, responsible, ethical behavior, in the spirit of the law, to ensure the professional reputation<br>· CT3 Demonstrating initiative and pro-active behavior for updating professional, economical and organizational culture knowledge |

**7. Objectives of the discipline** (outcome of the acquired competencies)

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| 7.1 General objective of the discipline | · Understanding of the main concepts and techniques of blockchain technology, with main focus on smart contracts |
| 7.2 Specific objective of the discipline | · To understand the execution model of Ethereum platform<br>· To understand bitcoin concepts<br>· To understand the execution of smart contracts<br>· To learn how to wite smart contracts<br>· To become familiar with the tools which automatically analise, optimize and verify smart contract |

**8. Content**

| 8.1 Course | Teaching methods | Remarks |
|---|---|---|
| 1. Introduction into Blockchain foundations and applications | Exposure, description, | |

| | | |
|---|---|---|
| | explanation, debate and dialogue, discussion of case studies | |
| 2. Basics of Ethereum | Exposure, description, explanation, debate and dialogue, discussion of case studies | |
| 3. Introduction in Smart contracts | Exposure, description, explanation, debate and dialogue, discussion of case studies | |
| 4. Smart contracts. Design patterns in Solidity | Exposure, description, explanation, debate and dialogue, discussion of case studies | |
| 5. Advanced topics on Solidity | Exposure, description, explanation, debate and dialogue, discussion of case studies | |
| 6. Decentralized Applications | Exposure, description, explanation, debate and dialogue, discussion of case studies | |
| 7. Bitcoins. Foundations | Exposure, description, explanation, debate and dialogue, discussion of case studies | |
| 8. Bitcoins. Advanced topics | Exposure, description, explanation, debate and dialogue, discussion of case studies | |
| 9. Consensus protocols. Foundations | Exposure, description, explanation, debate and dialogue, | |

| | | |
|---|---|---|
| | discussion of case studies | |
| 10. Consensus protocols. Advanced topics | Exposure, description, explanation, debate and dialogue, discussion of case studies | |
| 11. Security in Ethereum | Exposure, description, explanation, debate and dialogue, discussion of case studies | |
| 12. Mining strategies, Mining attacks | Exposure, description, explanation, debate and dialogue, discussion of case studies | |
| 13. Advanced topics on Blockchain verification | Exposure, description, explanation, debate and dialogue, discussion of case studies | |
| 14. The future of Blockchain | Exposure, description, explanation, debate and dialogue, discussion of case studies | |

Bibliography


1. (Main textbook-free available)Narayanan, Bonneau, Felten, Miller and Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction

2. Bonneau, Miller, Clark, Narayanan, Kroll and Felten , Research Perspectives and Challenges for Bitcoin and Cryptocurrencies

3. Jeremy Clark , an extensive online bibliography of Bitcoin research papers

4. Bitcoin Developer Reference

5. Satoshi Nakamoto , Bitcoin: A Peer-to-Peer Electronic Cash System

6. Ethereum extensive wiki

7. Bitcoin Wiki

8. A.M. Antonopoulos, G. Wood , Mastering Ethereum: Building Smart Contracts and DApps O'Reilly Media, 2018
9. A.M. Antonopoulos , Mastering Bitcoin , O'Reilly Media, 2017
10. A. Bahga, V. Madisetti , Blockchain Applications: A Hands-On Approach, VPT Publishing House, 2017
11. Solidity: https://solidity.readthedocs.io/en/v0.5.10/

| 8.2 Seminar / laboratory | Teaching methods | Remarks |
|---|---|---|
| • Configuration of Ethereum client<br>• Tools:Ganache<br>• Tools: Remix, Mcrypto<br>• Solidity: example<br>• Project assignment<br>• Solidity: advanced topics<br>• Metatask<br>• Design Patterns<br>• Decentralized Applications<br>• Java Script<br>• Java script: advanced topics<br>• Decentralized Applications: advanced topics<br>• Security<br>• Project evaluation | Conversation, debate, case studies, examples | |

Bibliography

1. Jeremy Clark , an extensive online bibliography of Bitcoin research papers
2. Bitcoin Developer Reference
3. Satoshi Nakamoto , Bitcoin: A Peer-to-Peer Electronic Cash System
4. Ethereum extensive wiki
5. Bitcoin Wiki
6. A.M. Antonopoulos, G. Wood , Mastering Ethereum: Building Smart Contracts and DApps O'Reilly Media, 2018
7. A.M. Antonopoulos , Mastering Bitcoin , O'Reilly Media, 2017
8. A. Bahga, V. Madisetti , Blockchain Applications: A Hands-On Approach, VPT Publishing House, 2017
9. Solidity: https://solidity.readthedocs.io/en/v0.5.10/

**9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program**

- The course respects the IEEE and ACM Curriculla Recommendations for Computer Science

studies;
- The content of the course is considered by the software companies as important for average software development skills

**10. Evaluation**

| Type of activity | 10.1 Evaluation criteria | 10.2 Evaluation methods | 10.3 Share in the grade (%) |
|---|---|---|---|
| 10.4 Course | know the basic principle of<br>the domain;<br>- apply the course concepts<br>- problem solving | Written final exam | 50% |
| 10.5 Seminar/lab activities | be able to use course concepts in solving the real problems | Practical Assignments | 50% |
| 10.6 Minimum performance standards | | | |
| ➢ At least grade 5 (from a scale of 1 to 10) at written final exam and at each laboratory assignment. | | | |

| Date | Signature of course coordinator | Signature of seminar coordinator |
|---|---|---|
| **20.05.2022** | **Assoc. Prof. Eng. Florin Craciun** | **Assoc. Prof. Eng. Florin Craciun** |

Date of approval ..... Signature of the head of department **Prof. PhD. Laura Dioșan**