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| **MINISTRY OF EDUCATION AND TRAINING**  **University​ Transport**  Department Information technology | **MINISTRY OF EDUCATION AND TRAINING**  **University of Transport and Communications**  Faculty of Information Technology |

COURSE OUTLINE

**dApp Development**

**( dApp application development )**

*General* **information**

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| - Course name: | DApp Development |
| - Course code: | IT1.303.3 |
| Training major/major | Computer Science |
| * Belongs to knowledge/skills:   🞎Basic industry knowledge 🞎Advanced industry knowledge  🗹Specialized knowledge In- 🞎depth specialized knowledge of principles and theories | |
| * Number of credits: | 3 |
| direct theoretical lessons (LT) : | 21 |
| + Number of online lessons if any (TT): | 9 |
| + BTL | 10 |
| + Course design |  |
| + Number of Discussion and Exercise periods | 15 |
| + Number of periods , practice , experiments ( TN/TH): | 15 |
| + Number of self- study periods : |  |
| * Prerequisites: |  |
| * Prerequisites: | Information security, Object-oriented programming, Web programming, Computer networks |
| * Parallel courses: |  |
| * Other requirements for the course: | Classroom with projector/Smart board |

**2. Course description***(course descriptions)*

- The course provides students with knowledge about encryption, hash functions, digital signatures, cryptocurrencies, ledgers, wallets, wallet addresses, blockchain, consensus algorithms, decentralization (DAO), smart contract concepts, programming techniques with Blockchain, etc.

- Students can apply knowledge of Blockchain and smart contracts to develop a decentralized application on some public blockchain platforms such as Cardano, Etherium, etc.

- Equip skills to analyze and evaluate the possibility of applying Blockchain in agencies and businesses, skills to choose solutions, technologies, means and ways to apply Blockchain technology to solve practical problems.

**3. Learning resources** *: course books, reference books, and softwares*

[1] . Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and StevenGoldfeder , *Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction* , Princeton University Press, 2016.

[2]. Imran Bashir, *Mastering Blockchain* , CRC Press, 2021.

[3]. Andreas M. Antonopoulos, Mastering Bitcoin, Second edition, O'Reilly, 2017

[4]. Andreas M. Antonopoulos andDr. Gavin Wood, Mastering Ethereum, First edition, O'Reilly, 2019

[ 5 ] . Narayan Prusty, Building Blockchain Projects, Develop real-time practical DApps using Ethereum and JavaScript, Packt Publishing, 2017.

[6]. Cardano Academy Cardano Blockchain Certified Associate (CBCA) Course , link

[7]. Daniel Drescher, *Blockchain Basics: A Non-Technical Introduction in 25 Steps* , ISBN-13 (pbk): 978-1-4842-2603-2, DOI 10.1007/978-1-4842-2604-9, 2020.

[8]. Jonh Greene, Cardano for the Masses, Publisher , 2022

*Course* **goals**

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| **Goal (G . x)** | **Describe the goal** | **Related CTDT's CDR** |
| **G. 1​** | Understand, apply encryption algorithms, data integrity, digital signatures, ledgers, wallets, wallet addresses, cryptocurrencies, blockchains , consensus algorithms, smart contract concepts, decentralization, cryptocurrencies, public blockchain, private blockchain in developing decentralized applications. | CDR6,7 (1.1) |
| **G. 2​** | Have the skills to evaluate and select areas that can apply Blockchain , develop and deploy decentralized applications. | CDR9 (2.1, 2.2) |

*5. Course* **learning** *outcomes*

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| **HP level 3 CDR**  **(Gxy) [1]** | **Description of course content [2]** | **General level of HP according to Bloom [3]** | |
| **Bloom level​​​** | **% of time​​** |
| **G.1.1** | Understand encryption algorithms, hash functions, data integrity, digital signatures, blockchains, ledgers, wallets, wallet addresses, cryptocurrencies, consensus algorithms. | 1.2 - TUA3 | 15% |
| **G1.2** | Apply smart contracts, cryptocurrencies, public blockchains in developing decentralized applications on Cardano, Etherium, ... | 1.2 - TUA3 | 35% |
| **G.2.1** | decentralized applications on popular Blockchain platforms | 2. 3.( 1-4) -TUA2 | 10% |
| **G.2.2** | Have the skills to evaluate and select areas where Blockchain can be applied | 4. 3.( 2-3) - TUA2 | 10% |

**6.** *Course* **assessment***​​​​*

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| **Evaluation Components** | **Assessment form (A . xy)** | **Cooperative education module officer ( G . xy)** | **Criteria**  **Evaluate** | **Percentage of points** |
| A1. Process assessment | A.1.1 Roll call  A1. 2. Multiple choice test | G.1.1  G.1.2 | Diligence  Answer the questions correctly | 10%  30% |
| End of course assessment | A2.1. Practice | G. 1.1​  G.1.2  G.2.1  G.2.2 | - Answer the questions correctly  - The program works properly | 60% |

**7. Teaching plan framework**

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| **TT** | **Contents [2]** | **Number of periods** | **HP CDR [3]** | **Teaching and learning activities [4]** | **Reviews [5]** |
| **1** | **Chapter 1. Basic knowledge**  1.1. Encryption  1.2. Hash function  1.3. Digital signature  1.4. Decentralized system  1.5. Distributed system  1.6. Peer-to-peer network | 3 LT  3 BT |  | **Lecturer:**  - Lecture 1.1-1.6  *Using the lecturing method*  - Give homework and guide students to read documents about theoretical knowledge learned.  **Student:**  - Study in class: Listen to theory lectures, do group exercises  - Study at home: Do exercises to reinforce theoretical knowledge learned |  |
| **2** | **Chapter 2.** **Blockchain Concepts**  2.1. Concept  2.2. History of Blockchain  2.2. Types of Blockchain Networks  2.3. Blockchain Generations  2.4. Cryptocurrencies and tokenomics  2.5. NFT  2.6. Wallet application  2.7. Number of pieces (ledge)  2.8. Application areas | 6 LT  3 BT | G1 .1 | **Lecturer:**  - Lecture 2.1-1.8  *Using the lecturing method*  - Give homework and guide students to read documents about Blockchain.  *Using team* -based-learning  **Student:**  - Study in class: Listen to theory lectures, do group exercises  - Study at home: Do exercises to reinforce knowledge about Blockchain | A1.2 |
| **3** | **Chapter 3.** **Blockchain Consensus Algorithms**  3.1. What is Blockchain consensus algorithm?  3.2. The importance of consensus algorithm for Blockchain  3.3. Byzantine Fault Tolerance (BFT)  3.4 Proof of Work (PoW) Algorithm  3.5. Proof of Stake (PoS) Algorithm  3.6. Delegated Proof of Stake (DPoS) Algorithm  3.7. Proof of History (PoH) Algorithm  3.8. Proof of Authority (PoA) Algorithm  3.9. Proof of Contribution (PoC) Algorithm | 6 LT  6 BT | G1.1 | **Lecturer:**  - Lecture 3.1- 3.9  *Using the lecturing method*  - Give homework, guide students to do homework on bitcoin mining, guide students to practice bitcoin consensus algorithms.  *Use the mutual communication method*  **Student:**  - Study in class: Listen to theory lectures, do group exercises, practice in the computer lab.  - Study at home: Do exercises to reinforce theoretical knowledge learned |  |
| **4** | **Chapter 4. Some Blockchain Platforms**  4.1. Bitcoin  4.2. Ethereum  4.3. Cardano  4.4. Some other platforms | 3 LT  3 BT  3 TH | G1.1  G1.2 | **Lecturer:**  - Lecture 4.1 - 4.4  *Using the lecturing method*  - Give exercises, guide students to do exercises on bitcoin mining, guide students to practice creating wallets, make transactions on the Test net of Cardano Blockchain.  *Use peer-to-peer or team* -based learning methods.  **Student:**  - Study in class: Listen to theory lectures, practice in the computer lab.  - Study at home: Practice what you have learned | A1.2 |
| **5** | **Chapter 5. Building Decentralized Applications**  5.1. Overview of building decentralized applications  5.2 Technology and tools in dapp application development  5.3 Building dapp applications on the cardano platform  5.4Build dapp applications on other platforms | 06 LT  06 BT  12 TH | G2.1  G2.2 | **Lecturer:**  - Lectures 5.1, 5.2, 5.3  *Using the lecturing method*  - Give exercises and guide students to program a simple smart contract on Cardano and Etherium platforms.  *Use team-based-learning method* .  **Student:**  - Study in class: Listen to theory lectures, do group exercises, practice in the computer lab.  - Study at home: Practice programming smart contracts as required by the instructor. | A.2 |

**8. Course requirements** *and expectations*

Students must attend all tests, attend at least 70% of in-class or online classes, and take the midterm exam to be considered for final course evaluation.

**9. Course manager**

- Faculty/Department: Computer Science

- Contact address and email: Room 309 Building A9

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| **Head of Department**  **Dr. Hoang Van Thong** | **HEAD OF EDITORIAL TEAM**  **Dr. Nguyen Duc Du** |