Title (Units): **COMP4137 Blockchain Technology and Applications (3,3,0)**

Course Aims: To introduce the concepts and applications of the blockchain technology; To explain the latest techniques of cryptocurrency and permissioned blockchains; To conduct case studies to apply the blockchain technology to practical applications.

Prerequisite: Year III Standing. Java programming is preferred.

Course Intended Learning Outcomes (CILOs):
Upon successful completion of this course, students should be able to:

No.	Course Intended Learning Outcomes (CILOs)
	Knowledge
1	Describe different types of blockchains and their applications
2	Explain the concepts and techniques of the cryptocurrency and consensus protocols
3	Explain the concepts and techniques of the smart contract and hyperledger
4	Explain the concepts and techniques of the advanced topics on blockchain
	Professional Skill
5	Suggest appropriate solutions to blockchain applications
6	Develop application prototypes using the blockchain technology

Calendar Description: This course provides an in-depth understanding and hands-on experience of the blockchain technology. Students will learn the concepts and techniques behind different types of blockchains, including mining mechanics, consensus protocols, smart contracts, and so on. Students will also learn blockchain application development skills via guided labs and projects.

Teaching and Learning Activities (TLAs):

CILOs	Type of TLA
1 - 4	Students will acquire the knowledge and skills on the blockchain technology through lectures, tutorials, assignments, quizzes, and guided labs.
2 - 5	Students will learn the development skills of blockchain applications via tutorials, assignments, quizzes, and guided labs.
5 - 6	Students will work on a group project to gain application development experience.

Assessment:

No.	Assessment Methods	Weighting	CILOs to be addressed	Description of Assessment Tasks
1	Continuous Assignments	30%	1 - 4	Assignments, quizzes, and labs are designed to evaluate students' mastery of blockchain concepts and techniques.
2	Group Project	10%	5 - 6	A group project is used to assess their problem solving and application development skills.
3	Examination	60%	1 - 5	Final examination questions are designed to assess how well students understand and utilize the knowledge acquired.

Assessment Rubrics:

	Excellent (A)	Good (B)	Satisfactory (C)	Fail (F)
Describe different types of blockchains and their applications	Thorough description of almost all types and applications	Description of most of the types and applications	Description of some of the types and applications	Description of a limited number of types and applications

Explain the concepts and techniques of the cryptocurrency and consensus protocols	Thorough explanation of almost all concepts and techniques	Explanation of most of the concepts and techniques	Explanation of some of the concepts and techniques	Explanation of a limited number of concepts and techniques
Explain the concepts and techniques of the smart contract and hyperledger	Thorough explanation of almost all concepts and techniques	Explanation of most of the concepts and techniques	Explanation of some of the concepts and techniques	Explanation of a limited number of concepts and techniques
Explain the concepts and techniques of the advanced topics on blockchain	Thorough explanation of almost all concepts and techniques	Explanation of most of the concepts and techniques	Explanation of some of the concepts and techniques	Explanation of a limited number of concepts and techniques
Suggest appropriate solutions to blockchain applications	Suggestion of almost all correct solutions	Suggestion of most of the solutions	Suggestion of some of the solutions	Suggestion of very small number of solutions
Develop applications using the blockchain technology	Thorough development of an application	Development of most parts of the application	Development of some parts of the application	Development of a very small part of the application

Course Content and CILOs Mapping:

Content		**CILO No.**
I	Introduction to Blockchain and Cryptography	1
II	Cryptocurrency	2, 5
III	Consensus Protocols	2, 5
IV	Smart Contract	3, 5, 6
V	Hyperledger	3, 5, 6
VI	Advanced Topics on Blockchain	4, 5

References:

- Mary C. Lacity and Steven C. Lupien, "Blockchain Fundamentals for Web 3.0", Epic Books, 2022
- Imran Bashir. Mastering Blockchain − Third Edition, Packt Publishing, 2020.
- Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and Cryptocurrency Technologies, Princeton University Press, 2016.
- Arshdeep Bahga and Vijay Madisetti. Blockchain Applications: A Hands-On Approach, VPT, 2017.
- Alan T. Norman. Blockchain Technology Explained: The Ultimate Beginner′ s Guide About Blockchain Wallet, Mining, Bitcoin, Ethereum, Litecoin, Zcash, Monero, Ripple, Dash, IOTA And Smart Contracts, CreateSpace Independent Publishing Platform, 2017.
- Henning Diedrich. Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations. CreateSpace Independent Publishing Platform, 2016.
- Andreas M. Antonopoulos and Gavin Wood, Mastering Ethereum: Building Smart Contracts and DApps, O'Reilly Media; 2018.

Course Content:

Topic

I. Introduction to Blockchain and Cryptography
   A. Overview of Blockchain
   B. Types of Blockchains
   C. Blockchain Applications
   D. Cryptographic Primitives

II. Cryptocurrency
   A. Overview of Cryptocurrency
   B. Attack and Security
   C. Bitcoin Mining
   D. Cryptocurrency Implementation

III. Consensus Protocols
   A. Fork and Fault Tolerance
   B. Permissionless and Permissioned Blockchains
   C. Consensus Algorithms: PoW, PoS, PBFT, Raft, etc

IV. Smart Contract
   A. Ethereum Virtual Machine
   B. Smart Contract, Dapp, DAO, and Token
   C. Developing Applications in Ethereum

V. Hyperledger
   A. Hyperledger Fabric
   B. Applications of Hyperledger Fabric
   C. Developing Applications in Hyperledger

VI. Advanced Topics on Blockchain
   A. Data Management
   B. Anonymity
   C. Privacy Protection
   D. Scalability: Lightning Network, Sharding, etc