Lahore University of Management Sciences

CS 3812 – Introduction to Blockchain Technologies and Applications
Spring -2022

COURSE DESCRIPTION
This is a beginners-level course that focuses on the foundational technologies behind blockchain. We will cover the concepts of distributed ledger, consensus mechanisms, authentication techniques, and relevant protocols. The course will provide case studies of blockchain applications such as cryptocurrencies, supply chain management, and B2B/B2C/C2C scenarios. The course will also provide hands-on experience with building and deploying smart contracts.

Course Distribution	
Core	No
Elective	Yes
Open for Student Category	All
Close for Student Category	None

COURSE PREREQUISITE(S)	
●	CS-200 Introduction to Programming

Instructor(s)	Basit Shafiq Zartash Uzmi Naveed Ul Hassan
Room No.	TBS
Office Hours	TBA
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Telephone	TBA
Secretary/TA	TBA
TA Office Hours	TBA
Course URL (if any)	TBA
Class Hours and venue	Tuesday/Thursday 17:00-18:15 Venue: TBA

Course Basics				
Credit Hours	3			
Lecture(s)	Nbr of Lec(s) Per Week	2	Duration	1 hour and 15 minutes
Recitation/Lab (per week)	Nbr of Lec(s) Per Week	0	Duration	
Tutorial (per week)	Nbr of Lec(s) Per Week	2	Duration	

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Course Teaching Methodology (Please mention following details in plain text)
The course lectures will be given in an in-person class. However, depending on the COVID-19 situation and government directives, we may temporarily switch to online teaching mode. To enhance student learning and encourage class participation, we will have regular assessments in the form of programming assignments, quizzes and homeworks.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)	
PEO-01	Demonstrate excellence in profession through in-depth knowledge and skills in the field of Computing.
PEO-02	Engage in continuous professional development and exhibit a quest for learning.
PEO-03	Show professional integrity and commitment to societal responsibilities.

COURSE OBJECTIVES	
	This course focusses on the foundational technologies behind blockchain. We will cover the concepts of distributed ledger, consensus mechanisms, authentication techniques, and relevant protocols. The course will provide case studies of blockchain applications such as, cryptocurrencies, supply chain management, and B2B/B2C/C2C scenarios. The course will also provide hands-on experience with building and deploying smart contracts.

COURSE LEARNING OUTCOMES (CLOs)			
CLO	CLO Statement	Bloom's Cognitive Level	PLOs/Graduate Attributes (Seoul Accord)
CLO1	To understand the basic concepts and structural aspects of blockchain and the reasons it is used.	C2	
CLO2	To be able to explain the various applications of blockchain.	C2	
CLO3	To understand the underlying technologies and protocols that make blockchain possible.	C2	
CLO4	To be able to write and analyze programs (smart contracts) that can run on blockchain	C3	
CLO5	To understand and analyze the positive and negative implications of using blockchain technology in various industries.	C4	

Assessment (tentative)	Weight (%)	Related CLOs	ACM Recommended Disposition
Programming Assignments (3-4) +HW (4-6)	30%	CLO1, CLO2, CLO3, CLO4	D3, D4, D7, D9
Quizzes (5-6)	20%	CLO1, CLO2, CLO3, CLO4, CLO5	D3, D4, D7, D9
Midterm (01)	20%	CLO1, CLO2, CLO3, CLO4, CLO5	D4, D7, D9
Final Examination (01)	30%	CLO1, CLO2, CLO3, CLO4, CLO5	D4, D7, D9

Examination Detail	
Midterm Exams	Yes/No: Yes
Final Exam	Yes/No: Yes

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COURSE OVERVIEW (tentative)

Week/ Lecture/ Module	Topics	Recommended Readings	Related CLOs	ACM Computing Knowledge Landscape

1	• Introduction to course, policies, grading scheme, etc.
	• Motivation behind blockchain
	• Overview of blockchain
	  1. Components of blockchain–Digital signatures–Hashing–Consensus mechanism
	  2. Smart contracts (overview)
	  3. Cryptocurrency (overview)
	  4. NFTs (overview)
			CLO1	

2	• Introduction to Bitcoin • Hash pointer • Bitcoin transaction • Block structure		CLO1, CLO3	
3	• Merkle tree • POW in detail • Mining and reward • Bitcoin Script • Partial and full nodes		CLO1, CLO3,	
4-5	• Shortcomings of bitcoin blockchain • Ethereum accounts (external and contract accounts) • Transactions and State • Smart contracts • Proof-of-stake • Variants of Ethereum blockchain		CLO1, CLO2, CLO3, CLO4, CLO5	
6	• Contract • Modifiers • Access types • Accounts • Gas • Examples		CLO2, CLO3, CLO4	
7	• Introduction to stacks		CLO1, CLO2, CLO3, CLO4	

	• Proof-of-Authority • Clarity			
8	• Hashing • Number theory • Digital signatures		CLO3	
9	• Attacks on blockchain • Privacy based blockchain • ZCash • Zero-knowledge-proof		CLO3, CLO4, CLO5	
10	• Consensus mechanisms • Forks of Ethereum • Introduction to quorum		CLO1, CLO2, CLO3, CLO4	
11 - 14	• Applications of blockchain (Double auction, Agriculture insurance, others) • Advanced topics (Decentralization finance, Regulatory matters, New internet)		CLO2, CLO4, CLO5	

Textbook(s)/Supplementary Readings

1. **Slides, and reference material, whitepapers, online resources**

Academic Honesty

The principles of truth and honesty are recognized as fundamental to a community of teachers and students. This means that all academic work will be done by the student to whom it is assigned without unauthorized aid of any kind. Plagiarism, cheating and other forms of academic dishonesty are prohibited. Any instances of academic dishonesty in this course will be forwarded to the SBASSE Disciplinary Committee. For further information, students should make themselves familiar with the relevant section of the LUMS student handbook.

Harassment Policy

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SSE, LUMS and particularly this class, is a harassment free zone. There is absolutely zero tolerance for any behavior that is intended, or has the expected result of making anyone uncomfortable and negatively impacts the class environment, or any individual's ability to work to the best of their potential.

In case a differently-abled student requires accommodations for fully participating in the course, students are advised to contact the instructor so that they can be facilitated accordingly.

If you think that you may be a victim of harassment, or if you have observed any harassment occurring in the purview of this class, please reach out and speak to me. If you are a victim, I strongly encourage you to reach out to the Office of Accessibility and Inclusion at oai@lums.edu.pk or the sexual harassment inquiry committee at harassment@lums.edu.pk for any queries, clarifications, or advice. You may choose to file an informal or a formal complaint to put an end of offending behavior. You can find more details regarding the LUMS sexual harassment policy [here](#).

To file a complaint, please write to harassment@lums.edu.pk.

SSE Council on Equity and Belonging

In addition to LUMS resources, SSE's **Council on Belonging and Equity** is committed to devising ways to provide a safe, inclusive and respectful learning environment for students, faculty and staff. To seek counsel related to any issues, please feel free to approach either a member of the council or email at cbe.sse@lums.edu.pk

Rights and Code of Conduct for Online Teaching

A misuse of online modes of communication is unacceptable. Live online lectures and tutorials will be recorded. However, the interaction with the students during office hours will not be recorded. If there is a need to record such interaction, faculty or TA will seek consent from the student first. Please ensure if you do not wish to be recorded during a session to inform the faculty member. Please also ensure that you prioritize formal means of communication (email, lms) over informal means to communicate with course staff.