Lingnan University

Course Syllabus

Course Title	:	Blockchain Technology
Course Code	:	CDS4101
Recommended Study Year	:	Year 4
No. of Credits	:	3
Mode of Tuition	:	Sectional Approach
Class Contact Hours	:	3 hours per week
Category	:	Major Required
Discipline	:	Nil
Prerequisite(s)	:	(a) CDS2005 Operating Systems for Data Science, and (b) CDS3001 Databases and Data Warehouses
Co-requisite(s)	:	Nil
Exclusion(s)	:	Nil
Exemption Requirement(s)	:	Nil

Brief Course Description:

Blockchain is the first successful technology that enables trust without relying on a central authority, revolutionizing how transactions and data are managed. This course aims to introduce the foundations of blockchain technology and explore its transformative impact on finance and beyond. It is designed to provide students with a solid understanding of key concepts and developments surrounding cryptocurrencies, distributed ledger systems, and decentralized applications. Students will learn about blockchain structure, cryptographic principles, and smart contracts, as well as how these technologies underpin financial innovations such as digital currencies, decentralized finance (DeFi), and tokenization. The course also highlights emerging applications, such as supply chain management, healthcare, and digital identity. Practical exercises will involve working with blockchain platforms, deploying smart contracts, and analysing real-world use cases in financial services and other industries.

Aims:

This course is designed to bridge the gap between foundational blockchain technology and its real-world applications in business and society.

1. Introduce the foundational principles of blockchain technology, including its architecture, cryptographic underpinnings, and core mechanisms for enabling trust without centralised authority.
2. Explore the transformative impact of blockchain across sectors, with a particular focus on financial innovations such as cryptocurrencies, decentralised finance (DeFi), and tokenisation.
3. Develop practical competence in working with blockchain platforms, deploying smart contracts, and analysing real-world use cases through hands-on exercises.
4. Examine emerging applications of blockchain beyond finance, including supply chain management, healthcare, and digital identity, highlighting its potential for cross-industry disruption.
5. Foster critical awareness of the technical, operational, and ethical considerations involved in implementing blockchain-based solutions.

Learning Outcomes (LOs)

Upon successful completion of this course, students will be able to:

1. Explain the core principles, architecture, and trust mechanisms of blockchain technology. (PILO1)
2. Analyse the role of blockchain in enabling financial innovations such as cryptocurrencies, DeFi, and tokenisation. (PILO1)
3. Apply cryptographic fundamentals and smart contract development to implement basic blockchain-based solutions. (PILO2)
4. Evaluate real-world blockchain use cases across sectors such as finance, supply chain, healthcare, and digital identity. (PILO3)
5. Critically assess the technical, ethical, and operational challenges associated with the adoption and governance of blockchain systems. (PILO7)

Indicative Contents:

Empathize – Understanding Users & Context

This module introduces the principles of human-centred design through user interviews, observation, empathy mapping, stakeholder analysis, and contextual inquiry to build a foundational understanding of users and their environments.

Define – Framing the Problem

Students learn to synthesize research insights into actionable frameworks by creating personas and user journeys and defining clear problem statements and design opportunities.

Ideate – Generating Creative Solutions

This module explores creative ideation techniques such as SCAMPER, mind mapping, and analogy thinking, supported by visual thinking, concept sketching, and structured idea selection and development frameworks.

Prototype – Making Ideas Tangible

Participants engage in low-fidelity prototyping using paper, digital, and physical methods, employing rapid prototyping tools and iterative design processes to integrate feedback and refine concepts.

Test – Learning from Users

This module covers user testing methods and feedback capture, guiding students through iterative refinement based on user insights and effective presentation of design solutions.

Design Ethics & Professional Practice

Focusing on professional readiness, this module addresses ethical considerations in design—including inclusion, sustainability, and privacy—along with storytelling, presentation skills, portfolio development, and reflective practice.

Teaching Methods:

This course adopts a sectional approach to deliver a structured and scaffolded learning experience. Core concepts, technological principles, and foundational frameworks are systematically introduced during lectures, which are enriched with real-world case studies and illustrative examples from finance, logistics, and governance. Following each lecture, scheduled tutorial sessions provide a collaborative and applied learning space where students engage in hands-on practical exercises, problem-solving tasks, and guided technical workshops. In these tutorials, students will work with key blockchain development tools—such as Solidity, Remix IDE, and Truffle—to implement smart contracts, analyse blockchain data, and explore decentralised application (DApp) prototypes. This integrated format ensures that theoretical knowledge is consistently reinforced through applied practice, while also fostering critical discussion, peer feedback, and the development of both technical proficiency and evaluative skills relevant to real-world blockchain implementation.

Measurement of Learning Outcomes:

Assessment / LOs	Class Attendance and Participation	Individual Assignments	Individual Project	Group Project and Presentation
	(10%)	(30%)	(30%)	(30%)
LO1	✓			
LO2		✓	✓	✓
LO3		✓	✓	✓
LO4		✓	✓	✓
LO5	✓		✓	✓

1. **Class Attendance and Participation (10%):** Students will be assessed by the following measures: a) class attendance (students are required to sign in for each session); b) active participation in lecture discussions and tutorial activities (e.g., contributing to case study analyses, engaging in technical problem-solving exercises, and participating in workshops on smart contract development and blockchain evaluation). Through class participation, students will demonstrate their understanding of core blockchain concepts (LO1) and their ability to engage in critical discussion of technical, ethical, and governance issues (LO5).

2. **Individual Assignments (30%):** Students will complete a series of individual assignments focused on foundational blockchain skills. These may include implementing cryptographic functions (LO2), writing and deploying a basic smart contract for a defined use case (LO3), or writing a critical analysis of a real-world blockchain application in finance or supply chain (LO4).
    - **Assignment 1: Cryptographic Foundations & Blockchain Integrity (10%)**
      This assignment focuses on the cryptographic underpinnings of blockchain technology. Students will complete a series of practical exercises using Python or a designated cryptographic library to demonstrate their understanding of core concepts, including hash functions (e.g., SHA-256), digital signature generation and verification, and public-key cryptography. They will then apply this knowledge to analyse a provided dataset simulating a simplified blockchain, where they must verify block integrity, validate the chain's continuity, and identify potential tampering. The final deliverable is a short technical report (approximately 500 words) that explains the role of these cryptographic mechanisms in establishing trust and security within a decentralised ledger, directly linking practical implementation to theoretical principles (LO2).
    - **Assignment 2: Smart Contract Development & Deployment (10%)**
      This assignment requires students to design, code, test, and deploy a basic smart contract on a blockchain test network (e.g., Ethereum Sepolia testnet). Using

Solidity within a development environment such as Remix IDE or Hardhat, students will implement a specified contract—for instance, a simple token (ERC-20) or a voting system—that includes key functions like transferring ownership or recording votes. The task involves writing comprehensive unit tests to verify contract functionality, conducting a basic security analysis to identify common vulnerabilities, and successfully deploying the contract. Submission includes the source code, deployment transaction details, and a brief narrative (approx. 400 words) explaining the contract's logic and its potential business or operational use case, assessing practical development skills (LO3).

- **Assignment 3: Blockchain Application Analysis Report (10%)**
  In this analytical assignment, students will select and critically evaluate a real-world blockchain application from a provided list (e.g., a DeFi protocol like Uniswap, a supply chain solution like VeChain, or a digital identity platform). Students must research the application's architecture, consensus mechanism, tokenomics (if applicable), and stated value proposition. The core task is to write a structured critical analysis (800–1000 words) that assesses the application's technical implementation, its claimed benefits, its limitations (e.g., scalability, user adoption, regulatory challenges), and its practical impact within its industry. The report should conclude with a justified judgement on the maturity and viability of the application, demonstrating the ability to evaluate blockchain use cases beyond theoretical understanding (LO4).

3. **Individual Project (30%):** Each student will undertake an individual project requiring the design and development of a functional blockchain-based component or a comprehensive analysis of a selected blockchain system. The project will assess the student's ability to frame a technical or business problem, implement a smart contract or analyse a distributed ledger solution (LO2, LO3), critically interpret the outcomes and their implications (LO4), and evaluate the solution's limitations, security aspects, and ethical considerations (LO5). The deliverable will be a technical report accompanied by a reproducible code repository or a detailed evaluative paper.

4. **Group Project and Presentation (30%):** Student teams will undertake a capstone project to design a blockchain-based solution for a complex, real-world challenge. The project will be assessed on the depth of problem scoping and solution architecture (LO2), the technical execution and sophistication of the implemented prototype or model (LO3), the clarity and persuasiveness of the insights and recommendations communicated (LO4), and the team's critical evaluation of the solution's validity, governance model, ethical considerations, and

strategic value (LO5). Deliverables will include a final group report, all source code and documentation, and a presentation of findings to a simulated stakeholder audience.

Assessment:

Class Attendance and Participation	10%
Individual Assignments	30%
Individual Project	30%
Group Project and Presentation	30%
Total	100%

Required/Essential Readings:

1. Nofer, M., Gomber, P., Hinz, O., & Schiereck, D. (2017). Blockchain. *Business & information systems engineering*, *59*(3), 183-187.
2. Lu, W., Wu, L., & Xue, F. (2022). Blockchain technology for projects: A multicriteria decision matrix. *Project management journal*, *53*(1), 84-99.
3. Sarmah, S. S. (2018). Understanding blockchain technology. *Computer Science and Engineering*, *8*(2), 23-29.

Recommended/Supplementary Readings:

1. Lu, W., Wu, L., Zhao, R., Li, X., & Xue, F. (2021). Blockchain technology for governmental supervision of construction work: Learning from digital currency electronic payment systems. *Journal of Construction Engineering and Management*, *147*(10), 04021122.
2. Iansiti, M., & Lakhani, K. R. (2017). The truth about blockchain. *Harvard business review*, *95*(1), 118-127.
3. Huynh-The, T., Gadekallu, T. R., Wang, W., Yenduri, G., Ranaweera, P., Pham, Q. V., ... & Liyanage, M. (2023). Blockchain for the metaverse: A Review. *Future Generation Computer Systems*, *143*, 401-419.
4. Dinh, T. T. A., Liu, R., Zhang, M., Chen, G., Ooi, B. C., & Wang, J. (2018). Untangling blockchain: A data processing view of blockchain systems. *IEEE Transactions on Knowledge and Data Engineering*, *30*(7), 1366-1385.
5. Pilkington, M. (2016). Blockchain technology: principles and applications. In *Research handbook on digital transformations* (pp. 225-253). Edward Elgar Publishing.
6. Maesa, D. D. F., & Mori, P. (2020). Blockchain 3.0 applications survey. *Journal of Parallel and Distributed Computing*, *138*, 99-114.

Important Notes:

(1) Students are expected to spend a total of 9 hours (i.e. 3 hours of class contact and 6 hours of personal study) per week to achieve the course learning outcomes.
(2) Students shall be aware of the University regulations about dishonest practice in course work, tests and examinations, and the possible consequences as stipulated in the Regulations Governing University Examinations and Course Work. In particular, plagiarism, being a kind of dishonest practice, is "the presentation of another person's work without proper acknowledgement of the source, including exact phrases, or summarised ideas, or even footnotes/citations, whether protected by copyright or not, as the student's own work". Students are required to strictly follow university regulations governing academic integrity and honesty.
(3) Students are required to submit writing assignment(s) using Turnitin.
(4) To enhance students' understanding of plagiarism, a mini-course "Online Tutorial on Plagiarism Awareness" is available on http://pla.ln.edu.hk/.
(5) Students must adhere to the University's guidelines and practices when using Generative Artificial Intelligence (GAI) tools. The official documents "Guidelines for Using GAI Tools at Lingnan University" and "Best Practices for Ethical and Responsible Use of GAI Tools in Course Assessments" can be found here: https://www.ln.edu.hk/tlc/generative-artificial-intelligence/gai-guidelines-best-practices.

Lingnan University

Course Rubrics

Rubric for Attendance and Participation (10%)

Criterion	Excellent (80-100)	Good (65-79)	Pass (50-64)	Fail (0-49)
Punctual to attend class (30%)	Always come to the class on time	Mostly come to the class on time	Sometimes come to the class on time	Seldom come to the class on time
Participation in class activities (70%)	Proactively participate in class activities, including the completion of in-class exercises, engaging in group discussion, and asking relevant questions in the Q&A session of group presentation. Demonstrate vigorous involvement	Participate as instructed in class activities including the completion of in-class exercises, engaging in group discuss, and asking relevant questions in the Q&A session of group presentation. Demonstrates ongoing involvement	Sometimes participate as instructed in class activities including the completion of in-class exercises, engaging in group discuss, and asking relevant questions in the Q&A session of group presentation. Demonstrates involvement	Seldom or never participate in class activities including the completion of in-class exercises, engaging in group discuss, and asking relevant questions in the Q&A session of group presentation. Seldom or rarely involves

1. Automated, quantitative record of sign-in time for each session: Digital attendance system (e.g., Moodle attendance tool, QR code scan). A late arrival is defined as arriving after the official session start time.
2. Structured observation using a standardized checklist aligned to rubric descriptors: Instructor/TA Checklist: A simple form for each session to log specific, observable student actions (see example below).

Rubrics for Assignments (30%)

Rubric for Assignment 1: Cryptographic Foundations & Blockchain Integrity (10%)

Criterion	Excellent (80–100%)	Good (65–79%)	Pass (50–64%)	Fail (0–49%)
Technical Accuracy & Implementation (40%)	All cryptographic exercises are executed flawlessly; code is efficient, well-documented, and runs without error. Blockchain verification is completely accurate.	Exercises are completed correctly with minor inefficiencies or documentation gaps. Verification is largely accurate.	Basic functionality is achieved but may contain errors or incomplete steps. Verification process is partially correct.	Significant errors in implementation; code fails to run or produces incorrect results. Verification is largely incorrect.
Analytical Understanding (40%)	Report demonstrates deep, nuanced understanding of cryptographic principles and their role in blockchain trust. Explanations are clear, critical, and well-supported.	Report shows solid understanding and correctly explains the link between cryptography and blockchain integrity.	Explanations are basic and descriptive, with limited critical insight or occasional inaccuracies.	Report is superficial, incorrect, or fails to explain the relevant concepts.
Clarity & Presentation (20%)	Report is exceptionally well-structured, professionally	Report is clear and logically organised. Communication	Report is understandable but may be disorganised,	Report is poorly structured, unclear, or does not

	written, and uses appropriate terminology. Visualisations or code excerpts enhance clarity.	is effective and meets all requirements.	contain unclear writing, or lack polish.	communicate the analysis effectively.

Rubric for Assignment 2: Smart Contract Development & Deployment (10%)

Criterion	Excellent (80–100%)	Good (65–79%)	Pass (50–64%)	Fail (0–49%)
Functionality & Correctness (50%)	Contract compiles and deploys without error; all specified functions operate as intended. Code is efficient, secure, and follows best practices.	Contract works correctly with minor issues (e.g., gas inefficiencies). All core functions are operational.	Contract is deployed and mostly functional but may have bugs or incomplete features.	Contract fails to compile, deploy, or does not meet core functional requirements.
Testing & Security (30%)	Comprehensive unit tests are provided, covering edge cases. Security analysis identifies potential vulnerabilities and suggests mitigations.	Adequate tests are included; basic security considerations are mentioned.	Limited testing; security discussion is superficial or incomplete.	No meaningful tests or security analysis provided.
Documentation & Explanation (20%)	Code is clearly commented; deployment details are	Code is documented; narrative explains the	Documentation is basic; narrative is brief or lacks depth.	Documentation is poor or missing; narrative is

	complete. Narrative is insightful, connects contract logic to real-world use, and is professionally presented.	contract adequately.		unclear or absent.

Rubric for Assignment 3: Blockchain Application Analysis Report (10%)

Criterion	Excellent (80–100%)	Good (65–79%)	Pass (50–64%)	Fail (0–49%)
Depth of Analysis (40%)	Analysis is critical, insightful, and goes beyond surface description. Clearly evaluates technical design, business model, limitations, and impact.	Analysis is thorough and covers main aspects competently. Identifies key strengths and weaknesses.	Analysis is descriptive rather than evaluative; may overlook key limitations or technical details.	Analysis is superficial, largely summary-based, or contains significant inaccuracies.
Use of Evidence & Research (30%)	Draws on multiple credible sources (academic, technical, industry). Arguments are well-supported with specific evidence and examples.	Uses relevant sources to support most points. Evidence is appropriate but may lack depth or variety.	Relies on limited or general sources; some claims are unsupported.	Little to no evidence provided; sources are inappropriate or absent.

Structure & Communication (30%)	Report is logically structured, compelling, and professionally written. Conclusions are clear, justified, and impactful.	Report is well-organised and clearly communicated. Meets format and length requirements effectively.	Report is understandable but may lack flow, contain grammatical issues, or have weak conclusions.	Report is poorly organised, difficult to follow, or does not meet submission standards.

Rubric for Individual Project (30%)

Criterion	Excellent (80–100%)	Good (65–79%)	Pass (50–64%)	Fail (0–49%)
Problem Definition & Scope (15%)	Project scope is exceptionally clear, well-justified, and demonstrates strategic insight into the chosen blockchain challenge. Objectives are specific, measurable, and aligned with real-world relevance.	Problem is clearly defined and appropriately scoped. Objectives are stated and relevant.	Problem statement is somewhat vague or overly broad. Objectives are basic or not fully aligned.	Problem is poorly defined, unclear, or irrelevant. Lacks clear objectives or scope.
Technical Execution & Implementation (30%)	Implementation is robust, well-structured, and demonstrates advanced technical skill. Code is modular, efficient, thoroughly	Implementation is complete and functional. Code is correct and adequately documented. May contain minor inefficiencies.	Implementation is basic and meets minimum requirements. Code may be disorganised, poorly documented, or	Implementation is incomplete, non-functional, or does not address core technical requirements.

	documented, and fully reproducible. Deployment (if applicable) is successful and professional.		contain noticeable gaps.	
Analysis & Interpretation of Results (25%)	Analysis is deep, critical, and yields non-obvious insights. Results are interpreted with nuance and clearly linked to the original problem. Demonstrates strong synthesis of technical outputs and business/social implications.	Analysis is logical and thorough. Results are correctly interpreted and connected to the problem. Insights are relevant and supported.	Analysis is descriptive rather than interpretive. Results are summarised but not critically examined. Insights are superficial.	Analysis is minimal, incorrect, or missing. Fails to derive meaningful conclusions from results.
Critical Evaluation & Ethical Awareness (20%)	Proactively and rigorously evaluates limitations, security risks, scalability constraints, and ethical implications (e.g., bias, access, environmental impact). Suggests well-reasoned	Identifies key limitations and ethical considerations. Evaluation is sound and covers main points.	Mentions limitations and ethics superficially. Lacks depth or critical perspective.	Fails to meaningfully address limitations, ethics, or broader implications.

	mitigation strategies.			
Professionalism & Documentation (10%)	Final report is of professional quality: well-structured, clearly written, visually polished, and supported by effective visuals. Code repository is impeccably organised and fully reproducible.	Report is clear, complete, and meets standards. Code is documented and reproducible with minor issues.	Report and documentation are passable but may lack clarity, structure, or completeness.	Work is poorly presented, undocumented, or submitted in an unacceptable format.

Rubric for Group Project and Presentation (30%)

1. **Group Project Component (20%)**

Criterion	Excellent (80–100%)	Good (65–79%)	Pass (50–64%)	Fail (0–49%)
Problem Scoping & Solution Design (20%)	Project scope is strategically framed, with clear alignment to a real-world challenge. Solution architecture is innovative, well-justified, and demonstrates deep understanding of blockchain potential and constraints.	Problem is well-defined and scoped appropriately. Solution design is logical, relevant, and technically sound.	Problem statement is somewhat broad or vague. Design is functional but lacks originality or clear justification.	Problem is poorly defined; solution is impractical, irrelevant, or misaligned with blockchain fundamentals.
Technical Implementation & Sophistication (30%)	Implementation is robust, scalable, and technically advanced. Demonstrates mastery of tools, secure coding practices, and integration of multiple components (e.g., smart	Implementation is complete and functional. Uses appropriate tools and follows good practices. May lack some optimisation or advanced features.	Core functions are implemented but may be basic, fragile, or poorly integrated. Contains noticeable technical gaps or errors.	Implementation is incomplete, non-functional, or fails to demonstrate required technical competencies.

	contracts, front-end, data feeds).			
Depth of Analysis & Business Relevance (25%)	Insights are profound, non-obvious, and strongly data-/model-driven. Recommendations are specific, actionable, prioritised, and directly tied to quantifiable business or social value.	Insights are clear and valuable. Recommendations are logical, supported by analysis, and relevant to the problem.	Insights are somewhat generic or descriptive. Recommendations are present but vague or weakly linked to analysis.	Insights are superficial or incorrect. Recommendations are missing, unrealistic, or not derived from the project work.
Critical Evaluation & Ethical Rigour (15%)	Comprehensive evaluation covers performance, scalability, security, governance, and ethics. Includes bias auditing, impact assessment, and concrete mitigation strategies. Demonstrates mature reflective practice.	Key limitations and ethical issues are identified and discussed appropriately. Evaluation is sound and covers main aspects.	Mentions limitations and ethics superficially. Evaluation lacks depth or critical insight.	Evaluation is minimal, missing, or fails to address material risks, ethics, or governance.
Cohesion & Professionalism of Deliverables (10%)	Final report, presentation deck, and code repository are seamlessly	Deliverables are complete, clear, and well-coordinated. Professional in	Deliverables are submitted but may feel disjointed, lack polish, or	Deliverables are incomplete, unprofessional, or fail to communicate

	integrated, polished, and tell a compelling story. Professional consultancy quality in structure, writing, and visual design.	tone and presentation.	contain inconsistencies.	the project coherently.

2. Individual Presentation Component (5%)

Criterion	Excellent (80–100%)	Good (65–79%)	Pass (50–64%)	Fail (0–49%)
Clarity & Delivery (50%)	Engaging, confident, and articulate. Pace, tone, and body language enhance communication. Speaks clearly and maintains audience engagement.	Clear and competent delivery. Minor issues with pace or audience engagement may be present.	Delivery is understandable but may be hesitant, monotonous, or lack confidence.	Unclear, disorganised, or unprepared delivery that hinders understanding.
Visual Aids & Structure (30%)	Slides/visuals are exceptionally clear, professional, and support the narrative effectively. Structure is logical and enhances	Visuals are clear and appropriate. Structure is logical and easy to follow.	Visuals or structure are basic, cluttered, or occasionally distract from the message.	Visuals are poor, confusing, or missing. Presentation lacks coherent structure.

	persuasive impact.			
Q&A Engagement (20%)	Responds actively and accurately to questions, elaborates with depth, and engages constructively with feedback. Demonstrates mastery of the project.	Responses are mostly accurate and relevant. Some elaboration is provided.	Responds but answers may be brief, contain errors, or lack relevance.	Disengaged, unable to answer, or responses are largely inaccurate.

3. **Peer Evaluation Component (5%) - Conducted confidentially via FeedbackFruits.**

Criterion	Excellent (80–100%)	Good (65–79%)	Pass (50–64%)	Fail (0–49%)
Contribution & Reliability (50%)	Consistently exceeded role expectations, initiated work, met all deadlines with high-quality output. Highly dependable.	Reliably completed assigned tasks on time and to a good standard. Contributed as expected.	Completed tasks but sometimes required reminders; quality or timeliness was inconsistent.	Failed to complete tasks, frequently late, or work quality was unacceptable.
Collaboration & Teamwork (50%)	Proactively supported team, communicated exceptionally well, resolved conflicts constructively, and helped others succeed.	Cooperated effectively, communicated adequately, and was a positive team member.	Participated but was sometimes passive, unresponsive, or communicated poorly.	Hindered group progress, was uncooperative, or created conflict.