BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
WORK INTEGRATED LEARNING PROGRAMMES

COURSE HANDOUT

Part A: Content Design

Course Title	Blockchain Technologies & Systems
Course No(s)	SE ZG569/SS ZG569
Credit Units	4
Course Author	AMIT DUA
Version No	1.0
Date	23/07/2020

Course Description:

This course introduces students to the fundamental concepts of Blockchain Technologies in the industry. This course involves the study of the basic principles of cryptography, distributed ledger architecture, foundational concepts of blockchains, blockchain based enterprise systems. The curse aims to focus on the solution architecture of business applications built on top of blockchain systems..

This course also introduces students to the development frameworks like Ethereum and HyperLedger to understand how they work. The main goal of this course is to make students learn how blockchain systems have been used to solve business problems and use cases by having closer looks at several blockchain based business applications.

In summary, the course equips students with knowledge and skill to develop blockchain based business solutions.

Course Objectives.

No	Objective
CO1	To learn the basic principles of cryptography and understand the foundation concepts blockchain technology
CO2	To comprehend and develop knowledge around fundamentals of blockchain systems, the technology and algorithms behind it.
CO3	To get acquainted with top development frameworks in technology markets like Hyperledger and Ethereum frameworks and see how blockchain systems can be developed using them.
CO4	To have a deep understanding of how blockchains systems are being adopted in various business use cases across industries across the globe. This would develop the skill of conceptual design of business applications using blockchain.

Text Book(s)

T1	Tiana Laurence, **Introduction to Blockchain technology,** 1st Edition, Van Haren Publishing
T2	Xiaofeng Chen, Hai Jiang, Elisa Bertino , **Essentials of Blockchain Technology**, 3rd Edition, CRC Press

Reference Book(s)

R1	Nakul Shah, **Blockchain for Business with Hyperledger Fabric,** 1st Edition, BPB Publications
R2	Xiwei Xu, Ingo Weber and Mark Staples, **Architecture for Blockchain applications**, 1st Edition, Springer
R3	Adidas Wilson, **Mastering Ethereum & Blockchain**, 2nd Edition, UOH Publishing

Content Structure

1. **Blockchain Foundations: Cryptography & Distributed ledger technology**
   1.1. Elements of Cryptography
   1.2. Public key cryptography
   1.3. Hashing
   1.4. Centralized Vs Decentralized computing
   1.5. Ledger transactions & trade
   1.6. Distributed ledger technology.
   1.7. Peer to peer technology.
2. **Blockchain foundation**
   2.1. Overview of Blockchain
   2.2. Concepts: Consensus & Proof of work/stake/value/capacity
   2.3. Concepts: Adding new block, forking
   2.4. History of blockchain
   2.5. Bitcoin framework
   2.6. Blockchain properties
   2.7. Varieties of blockchain
3. **Blockchain & System architecture**
   3.1. Blockchain design patterns
   3.2. Security & Privacy in blockchain systems
   3.3. Performance aspects of blockchain
   3.4. Blockchain in software architecture
   3.5. Integrating blockchain into enterprise applications
   3.6. Blockchain & smart contract vulnerabilities
   3.7. Frauds and scams

4. **Blockchain frameworks**
    4.1. Understanding Hyperledger
    4.2. Hyperledger Fabric, tools & applications
    4.3. Designing D'Apps with Hyperledger
    4.4. Basics of Ethereum
    4.5. Smart contracts and implementation using Ethereum
    4.6. Ethereum wallets and mining

5. **Business applications of blockchain technology**
    5.1. Smart contracts driven business transactions
    5.2. IoT cybersecurity management using blockchains
    5.3. Blockchain for global healthcare
    5.4. Car registration & Electronic voting use cases
    5.5. Fintech business applications of blockchain
    5.6. Identity applications of blockchain
    5.7. Artificial Intelligence & blockchain

6. **Blockchain and Industry applications**
    6.1. Blockchains in supply chain industry
    6.2. Cross border money transfers
    6.3. Digital fiat currency
    6.4. Blockchain for Insurance industry
    6.5. Intellectual property rights using blockchain
    6.6. Governance and citizen services using blockchain

7. **Case Studies on Blockchain applications**
    7.1. AgriDigital - Cloud based commodity managed blockchain application for agriculture
    7.2. SecureVote - Digital voting and governance built on blockchain systems
    7.3. OriginTrail - Open source protocol for trusted data exchange in the global supply chain using blockchain.

Learning Outcomes:

No	Module	Learning Outcomes
LO1	1	Learn the cryptographic ecosystem upon which blockchains technologies are built.
LO2	2, 3	To understand and develop the tactical concepts of blockchains and their nuances. These nuances are the building blocks of blockchains. This would be the stepping stone for understanding not only the architecture of blockchain but also how blockchains fits into the enterprise architecture of business applications
LO3	4	To acquire the understanding of technology components in development of blockchain applications upon Hyperledger and Ethereum frameworks
LO4	5,6	Explore and understand the business applications and the ecosystem in which blockchain is solving real problems for business in various industries.

Part B: Contact Session Plan

Academic Term	First Semester 2023-2024
Course Title	**Blockchain Technologies & Systems**
Course No	SE ZG569 / SS ZG569
Lead Instructor	AMIT DUA

Course Contents

Contact Session	List of Topics	Reference
01, 02	**1. Blockchain Foundations: Cryptography & Distributed ledger technology** a. Elements of Cryptography b. Public key cryptography c. Hashing d. Centralized Vs Decentralized computing e. Ledger transactions & trade f. Distributed ledger technology. g. Peer to peer technology.	**T1: Chapter 02**
03, 04, 05	**2. Blockchain foundation** a. Overview of Blockchain b. Concepts: Consensus & Proof of work/stake/value/capacity c. Concepts: Adding new block, forking d. History of blockchain e. Bitcoin framework f. Blockchain properties g. Varieties of blockchain	**T1: Chapter 03, T2: Chapter 01, 02**
06, 07	**3. Blockchain & System architecture** a. Blockchain design patterns b. Security & Privacy in blockchain systems c. Performance aspects of blockchain d. Blockchain in software architecture e. Integrating blockchain into enterprise applications f. Blockchain & smart contract vulnerabilities g. Frauds and scams	**R2: Chapter 7, 10, 5, T2: Chapter 5 T1: 10.1, 10.3**

08, 09, 10, 11	4. **Blockchain frameworks**
	   1. Understanding Hyperledger
	   2. Hyperledger Fabric, tools & applications
	   3. Designing D'Apps with Hyperledger
	   4. Basics of Ethereum
	   5. Smart contracts and implementation using Ethereum
	   6. Ethereum wallets and mining
		R1: Chapter 02, 03, 6, 7, 8
		
		R3: 4, 5, 7

12, 13	**5.Business applications of blockchain technology**
	   1. Smart contracts driven business transactions
	   2. IoT cybersecurity management using blockchains
	   3. Blockchain for global healthcare
	   4. Car registration & Electronic voting use cases
	   5. Fintech business applications of blockchain
	   6. Identity applications of blockchain
	   7. Artificial Intelligence & blockchain
		T1: Chapter 6
		T2: Chapter 7, 8, 9, 10

14,15	6. **Blockchain and Industry applications**
	   1. Blockchains in supply chain industry
	   2. Cross border money transfers
	   3. Digital fiat currency
	   4. Blockchain for Insurance industry
	   5. Intellectual property rights using blockchain
	   6. Governance and citizen services using blockchain
		T1: Chapter 7, 8, 9

16, 17, 18	7. **Case Studies on Blockchain applications**
	   1. AgriDigital - Cloud based commodity managed blockchain application for agriculture
	   2. SecureVote - Digital voting and governance built on blockchain systems
	   3. OriginTrail - Open source protocol for trusted data exchange in the global supply chain using blockchain.
		R2: Chapter 12, 13 https://origintrail.io/

Important Information:

- Syllabus for Mid-Semester Test: Topics in CS 1-8.

- Syllabus for Comprehensive Exam: All topics given in plan of study

- Mode of Mid-Sem /Comprehensive Exam: TBA (Open Book / Closed Book)

Evaluation Scheme:

Legend: EC = Evaluation Component; AN = After Noon Session; FN = Fore Noon Session

No	Name	Type	Duration	Weight	Day, Date, Session, Time
EC-1	Quiz-I	Online	-	5%	September 1-10, 2023
	Quiz-II	Online		5%	October 1-10, 2023
	Assignment-I	Online		20%	November 1-10, 2023
EC-2	Mid-Semester Test	Closed Book	2 hours	30%	Sunday, 24/09/2023 (AN)
EC-3	Comprehensive Exam	Open Book	2 ½ hours	40%	Sunday, 26/11/2023 (AN)

Notes:

- ✓ The release dates of Quiz-1/2 and assignments will be 5 days (for Quiz) and 10 days (for assignments) before the completion/submission deadline.

- ✓ **Deadlines will NOT be extended for whatever reason** and the student is requested not to wait for the deadline to start working on Quiz/Assignment

- ✓ Syllabus for Quiz-I: Sessions: 1 to 3 / Quiz-II : Session 9 to 12

- ✓ Syllabus for Assignment: Hands-on Python-based Exercise (real-world problem, for individual group of 3 / 4 students). Group formation procedure will be announced before Assignment release

- ✓ All Quiz/Assignments will be released and to be answered/submitted in Canvas LMS

- ✓ Syllabus for Mid-Semester Test (Closed Book): Topics in Session Nos. 1 to 8

- ✓ Syllabus for Comprehensive Exam (Open Book): All topics (Session Nos. 1 to 16)

- ✓ The student is strictly advised to stick to regular schedule of Mid-Sem and Compre examinations, and Makeup examinations will be only for those students with business-related absence/health related issues.

- ✓ Strictly NO MAKEUPS for Quiz and Assignments and all submissions after the above stated deadlines will not be considered/evaluated.

- ✓ All students should conform to BITS students' ethical code-of-conduct and all assignments will be subjected to plagiarism check, and if violated will be subject to disciplinary action apart from nullifying all the marks/grades assigned.

Important links and information:

Canvas LMS/ eLearn Portal: All materials/announcements/discussions forums/Online Quizzes/Assignment submissions will be via Canvas / / eLearn LMS portal. Students are expected to monitor this portal regularly for any content or announcements.

Contact sessions: Students should attend the online lectures as per the schedule provided in the Course Handout (posted on Canvas / / eLearn LMS)

Evaluation Guidelines:

1. EC-1 consists of 2 Quizzes and 1 Assignments. Students will attempt them through the course pages on the Canvas / / eLearn portal. Announcements will be made on the portal, in a timely manner.

2. For Closed Book tests: No books or reference material of any kind will be permitted.

3. For Open Book exams: Use of books and any printed / written reference material (filed or bound) is permitted. However, loose sheets of paper will not be allowed. Use of calculators is permitted in all exams. Laptops/Mobiles of any kind are not allowed. Exchange of any material is not allowed.

4. If a student is unable to appear for the Regular Test/Exam due to genuine exigencies, the student should follow the procedure to apply for the Make-Up Test/Exam which will be made available on the Canvas/ eLearn portal. The Make-Up Test/Exam will be conducted only at selected exam centers.

It shall be the responsibility of the individual student to be regular in attending the contact-session schedule as given in the course handout, and take all the prescribed evaluation components such as Assignment/Quiz, Mid-Semester Test and Comprehensive Exam according to the evaluation scheme provided in the handout