



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Information Technology

Subject Code: DI05016051

Subject Name: Foundation of Blockchain

w. e. f. Academic Year:	2026-27
Semester:	5 th
Category of the Course:	PEC-IV

Prerequisite:	Students should have basic knowledge of programming concepts such as variables, functions, and control structures. A fundamental understanding of computer networks and how systems communicate over the internet is expected. Basic knowledge of database systems and data handling will be helpful. Familiarity with operating systems and file management is desirable. Analytical thinking and logical reasoning skills will support understanding of cryptographic concepts.
Rationale:	This course introduces students to blockchain technology and its role in modern decentralized systems. It builds a strong foundation in cryptography, distributed networks, and consensus mechanisms. Students gain practical skills in smart contract development and blockchain tools. The course covers real-world applications including finance, healthcare, and supply chain. It also prepares students for emerging trends and challenges such as security and green blockchain solutions.

Course Outcome:

After Completion of the Course, Student will be able to:

No	Course Outcomes	RBT Level
01	Explain basic concepts of cryptography and decentralized systems.	Understand
02	Describe working of Proof-of-Work consensus Mechanisms.	Understand
03	Develop and Deploy Simple Smart Contracts using Solidity.	Apply
04	Explain architecture and application of Permissioned blockchains.	Understand
05	Identify basic security issues and application of blockchain technology.	Remember/ Understand

**Revised Bloom's Taxonomy (RBT)*



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Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE(E)	PA(M)	PA(I)	ESE(V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Foundations of Decentralization 1.1 Introduction to Cryptography: 1.1.1 Evolution of Money & Centralized vs. Decentralized systems 1.1.2 Cryptographic Hash Functions (SHA-256) and their properties 1.1.3 Public Key Cryptography: Digital Signatures 1.1.4 CAP Theorem 1.2 The Anatomy of a Block 1.2.1 Data, Hash, and the "Previous Hash" link 1.2.2 Merkle Trees and efficient data verification 1.2.3 Distributed Ledger Technology(DLT) vs Traditional Databases 1.3 Network Consensus 1.3.1 The Byzantine Generals Problem 1.3.2 Peer-to-Peer (P2P) Network Architecture 1.3.3 Introduction to Consensus Algorithms: Why we need agreement	10	20
2.	Bitcoin & The Proof-of-Work Era 2.1 The Bitcoin Protocol 2.1.1 UTXO (Unspent Transaction Output) Model vs. Account Model 2.1.2 Bitcoin Wallets: Hot vs. Cold storage and Seed Phrases 2.2 Mining & Game Theory	08	15



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	2.2.1 Proof of Work (PoW) and the concept of "Difficulty" 2.2.2 The Life Cycle of a Transaction (Mempool to Block) 2.2.3 Mining Incentives: Block Rewards and Halving 2.3 Advanced Consensus Mechanisms 2.3.1 Proof of Stake (PoS) – Energy efficiency and "Slashing" 2.3.2 Comparison: PoW vs. PoS 2.3.3 The Role of Forks in Consensus		
3.	Ethereum & Smart Contracts 3.1 Ethereum Essentials 3.1.1 Ethereum Virtual Machine (EVM) and Gas Fees 3.1.2 Ether (ETH) vs. Tokens (ERC-20 basics) 3.2 Introduction to Solidity 3.2.1 Solidity Syntax: Variables, Functions, and Mappings 3.2.2 Writing your first "Hello World" Smart Contract 3.2.3 Compiling and Deploying on a Testnet (Remix IDE) 3.2.4 Introduction of MetaMask	12	30
4.	Enterprise & Private Blockchains 4.1 Hyperledger Fabric 4.1.1 Public vs. Private (Permissioned) Blockchains 4.1.2 Hyperledger Architecture: Peers, Orderers, and Channels 4.1.3 Introduction to Chaincode (Smart Contracts in Hyperledger) 4.2 Enterprise Use Cases 4.2.1 Supply Chain Management: Tracking provenance 4.2.2 Blockchain in Healthcare: Secure patient records 4.2.3 Identity Management: Self-Sovereign Identity (SSI)	07	20
5.	Security, Emerging Trends & Green Energy 5.1 Blockchain Security & Risks 5.1.1 Common Smart Contract Vulnerabilities (Re-entrancy attacks) 5.1.2 51% Attacks and Sybil Attacks 5.2 Emerging Trends 5.2.1 Decentralized Finance (DeFi): Yield Farming and Liquidity Pools	08	15



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	5.2.2 NFTs (Non-Fungible Tokens) and the Metaverse 5.2.3 DAOs (Decentralized Autonomous Organizations) 5.3 Blockchain in Green Energy 5.3.1 The Problem of Greenwashing & Tokenization of Energy 5.3.2 Oracle Problem: How do we trust the data? 5.3.3 Introduction of IoT Oracles		
	Total	45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
24	28	18	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Mastering Bitcoin: Unlocking Digital Cryptocurrencies	Andreas M. Antonopoulos	O'Reilly Media, 2017 (2nd Ed)
2	Mastering Ethereum: Building Smart Contracts and DApps	Andreas Antonopoulos & Gavin Wood	O'Reilly Media, 2018
3	Blockchain Basics: A Non-Technical Introduction in 25 Steps	Daniel Drescher	Apress, 2017
4	Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions	Joseph Bambara & Paul R. Allen	McGraw-Hill, 2018
5	Hands-On Blockchain with Hyperledger	Nitin Gaur et al.	Packt Publishing, 2018



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(b) Open-source software and website:

1. Remix Online IDE <https://remix.ethereum.org>
2. Cyfrin Updraft <https://updraft.cyfrin.io>
3. CryptoZombies <https://cryptozombies.io>
4. MIT OpenCourseWare: Blockchain and Money
<https://ocw.mit.edu/courses/15-s12blockchain-and-money-fall-2018/>
5. Hyperledger Fabric Documentation <https://hyperledger-fabric.readthedocs.io>
6. OpenZeppelin Contracts <https://docs.openzeppelin.com/contracts>

Suggested Course Practical List:

The following practical outcomes (PrOs) are the subcomponents of the COs. These PrOs need to be attained to achieve the COs.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	To understand how cryptographic hash functions convert input data into fixed-length outputs and to demonstrate the "Avalanche Effect."	1	4
2	To generate a public/private key pair and understand how digital signatures ensure data authenticity.	1	2
3	To create a basic blockchain structure in Python demonstrating how blocks are cryptographically linked.	1	2
4	To manually construct a simplified Merkle Tree to understand efficient data verification.	1	4
5	To understand the concept of a "Nonce" and how mining difficulty secures a network.	2	2
6	To understand how wallets generate keys from mnemonic seed phrases.	2	4
7	To write, compile, and deploy a basic smart contract on the Ethereum Virtual Machine (EVM).	3	4



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8	To understand tokenization by deploying a basic ERC-20 token contract. Tools Required: Remix IDE.	3	4
9	Case Study 1 : To differentiate between Public and Private Blockchains by exploring Hyperledger Fabric concepts.	4	2
10	Case Study 2 : To identify a common security vulnerability and conceptualize a Green Energy DAO/Token system.	5	2
		Total	30

Note :- More Practical Exercises can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.

List of Laboratory/Learning Resources Required:

Sr. No.	Laboratory/Learning Resources/Equipment Name with Broad Specifications	PrO. No.
1	Computer system with operating system: windows 10 or higher version, macOS and Linux, with 4GB or higher RAM, Python version : 2.7.X,3.6.X or higher version,	All
2	Remix IDE, Metamask, Solidity, Hyperledger fabric/IBM platform	6 to 10

Sample Projects: (if required)

- Mini Blockchain Implementation
- Student Certificate Verification System
- Decentralized Voting Application (D-Vote)
- Supply Chain Provenance Tracker
- Healthcare Record Management System
- Green Energy Tokenization Platform
- Decentralized IoT Data Logging

Suggested Activities for Students: (if required)

Other than the classroom and laboratory learning, following are the suggested student related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- Classroom Debates & Group Discussions



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- b) Case Study Presentations
- c) "Read the Whitepaper" Reading Club
- d) Hands-on Web3 Exploration (No-Code)
- e) Code Auditing Challenge ("Spot the Bug")

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