BLOCKCHAIN

PL T P C

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Course Objective:

1. Ability to develop a structure of data with inherent security qualities based on principles of cryptography, decentralization, and consensus
2. Develop smart contracts using the Solidity programming language (including a deep understanding of the provided Libraries)
3. Implement the consensus methods in transactions and apply blockchain for different application domains
4. Develop your own applications for various user requirements using Blockchain and launch it for public and commercial use
5. Apply Hyperledger Fabric and Ethereum platform to implement the Block Chain Application.

Course Outline:

UNIT 1: Introduction and Overview of Blockchain **3 + 6**

Introduction | What is a Blockchain? | Why Blockchain? | Types of Blockchain | Scope and Importance of the Technology | Future Opportunities | Blockchain Platforms | Miners - the Nonce and the Cryptographic Puzzle | Proof of Work & Proof of Stake | Consensus Algorithms | Fault Tolerance Mechanism | Creation of a Block | Transaction Record

UNIT 2: Blockchain - the Future of Digital currency **3 + 6**

What is Bitcoin? | Bitcoin's Monetary Policy | Bitcoin Wallets | Application of Bitcoins | Bitcoin - Script, Address and Transaction | Understanding Mining Difficulty | Virtual Tour of Bitcoin Mine | Mining Pools | Nonce Range | How Miners Pick Transaction | CPU's Vs GPU's Vs ASIC's | How does Mempools Work | Orphaned Blocks | The 51% Attack | How Wallets Work | Signatures: Private and Public Keys Demo: Setting up a Wallet, Signatures & Key

UNIT 3: Ethereum **3 + 6**

What is Ethereum? | Types of Ethereum Accounts | Ethereum Mining | Ethereum Complete Ecosystem | DApps | DAOs | Ethereum Virtual Machine and Gas | Swarm & Whisper

UNIT 4: Smart Contracts **3 + 6**

What is a Smart Contract? | Smart Contract Environment | Solidity Programming | Array, Enum and Structs | Inheritance | ERC20 | ERC721

UNIT 5: Hyperledger and IPFS **3 + 6**

What is Hyperledger? | Importance of Hyperledger | Hyperledger Architecture & its Layers | Hyperledger Transactions | Hyperledger Fabric | Hyperledger Fabric Model | Building a Hyperledger Fabric Network | Fabric Peer | Hyperledger Fabric CA | Sawtooth | Iroha & Indy | API in Hyperledger | Network Topology in Hyperledger | IPFS Introduction | IPFS Working | IPFS for Blockchain Application

Course Outcome:

1. He / She can write a smart contract to insert a value into the Ethereum blockchain using metamask

2. He / She is able to navigate the Remix IDE web URL on the browser and explore the various tabs and features of the IDE

3. He / She can connect to the Ganache localhost through Web3 provider, Ropsten testnet using Metamask and Injected Web3

4. He / She is able to write a Program on the arrays in the Solidity with regards to fixing the length and dynamic

5. He / She can generate the ABI and Bytecode of a Smart Contract by compiling the solidity file

6. He / She can develop a program that transfers the smart contracts between the parties which can aid in automated

LIST OF EXPERIMENTS:

- How to navigate to the Remix IDE web URL on the browser and exploring the various tabs and features of the IDE.

- How to connect to the Ganache localhost through Web3 provider and to the Ropsten testnet using Metamask and Injected Web3

- Write a Program to understand the solidity variables and its properties.

- Write a Program to understand the arrays in the Solidity with regards to fixed length array and dynamic array.

- Muthu Muhilan is an instructor for Blockchain and Cryptocurrency, as part of the course, He wants to set the environment to deploy smart contract help him to deploy a smart contract

- Dhanalakshmi is a student in Government Engineering College city school in Mayiladuthurai, Her teacher gave her homework to check whether a number is Incrementing or Decrementing. Help her to solve the problem

- Saravanan started learning solidity language, He completed his theory classes now it is time for the practical session. He was given a problem printing the string “Naan Mudhalvan”. Help him to print the String.

- How to write a smart contract to insert a value into the Ethereum blockchain using metamask.

- You had a friend in the United States of American who’s studying Computer Science Engineering at Stanford University, California. He asked you for help for transferring Ethers through online so he can pay a fee to the college. Use Metamask for transferring the Ethers to your friend.

- Write a Program to generate the ABI and Bytecode of a Smart Contract by compiling the solidity file.

- Write a Solidity program to develop a smart contract that can aid automated property transfer between parties.

- A finance company wishes to use Ethereum platform to speed up and simplify payments deposits. You are an Ethereum developer and have been asked by the company to create a Smart Contract for a banking application. Create a Smart Contract for a banking application in solidity which allows users to do the following:
    - Mint money into your account
    - Withdraw money from your account
    - Send money from your account to smart contract address
    - Check balance

    - After a contract is created, deploy the contract on Ethereum Testnet network

- To design an electronic voting system, using the ethereum blockchain (smart contracts) and more precisely the RPC test which enables account generation with a private and public key. Blockchain electronic voting system using smart contracts.

- Write a Program to develop a smart contract to issue the custom ERC 20 token using solidity.

- Write a Program to store the values to the blockchain and then to retrieve the same from the blockchain.

- How to write a smart contract to insert value into the ethereum blockchain using Ganache (using intranet)

20 INDUSTRY USE CASES

Problem Statement: 1

Blockchain technology came into the ground to overcome these issues. It offers decentralized nodes for the banking system and is used to produce a transparent banking system for its end-to-end verification advantages. This technology is a replacement for the traditional banking system with distributed, nonrepudiation, and security protection characteristics.

You are a Blockchain expert in a major corporate bank and have been tasked to create a smart contract to perform banking transactions. Create a Smart Contract for a banking application in solidity that allows users to do the following:

• Mint money into your account

• Withdraw money from your account

• Send money from your account to smart contract address

• Check balance

Problem Statement: 2

Blockchain is a technology designed to manage patient data that has the potential to support transparency and accountability. A blockchain is a ledger of transactions where an identical copy is visible to all the members of a computer network. Network members validate the data entered into the ledger, and once entered, the data is immutable.

Create a solution where you can store the electronic health record of the patients in a distributed and decentralized network. You should be able to query and change the ownership of the record as necessary.

Problem Statement: 3

Blockchain is a technology designed to manage education data that has the potential to support transparency and accountability. A blockchain is a ledger of transactions where an identical copy is visible to all the members of a computer network. Network members validate the data entered into the ledger, and once entered, the data is immutable.

Design a solution where you can store the digital certificates of the students in a distributed and decentralized network. You should be able to add the certificated details into the blockchain query the certificate details from the blockchain.

Problem Statement: 4

Blockchain is a technology which enables elections to be done transparently. We can avoid rigging or any corrupt activities using the technology and should be able to make sure that the votes are also accounted for on a real-time basis.

Design an electronic voting system, using the ethereum blockchain (smart contracts) and more precisely the RPC test which enables account generation with a private and public key. Blockchain electronic voting system using smart contracts..

Problem Statement: 5

Smart cities and smart houses are in fashion and thus all this can be kept in a blockchain. We can focus on building system which can manage all the real estate related contracts through blockchain technology which will enhance security and will provide more efficiency.

Design a smart contract using the Ethereum blockchain in a distributed and decentralized network. You should be able to add the property details to the blockchain, query the property details from the blockchain and should be able to change the ownership of the property appropriately.

Problem Statement: 6

Food items like fruits and vegetables generally do not have any expiry date mentioned so it becomes important to understand the origin of these food items and know the date when was it sent to the distributor from the farmer and so on.

Design a smart contract using the ethereum blockchain where you should be able to authenticate the food item and consume that without any worry

Problem Statement: 7 (Identity)

Blockchain is a technology that enables identities to be stored transparently. It offers decentralized nodes for end-to-end verification advantages. This technology is a replacement for traditional identity management with distributed, nonrepudiation, and security protection characteristics.

Design a smart contract using the Ethereum blockchain where you should be able to store the identity details in the blockchain and should be able to query the details of the identity from the blockchain

Problem Statement: 8

Blockchain is a technology that allows you to store books transparently. It offers decentralized nodes for the end-to-end verification advantages in the library. This technology is a replacement for a traditional book management system with distributed, non-repudiation, and security protection characteristics.

Design a smart contract using the Ethereum blockchain where you should be able to store your book details in the blockchain and should be able to query the details of the books from the blockchain and if required we should be able to change the ownership of the books and the same should be updated in the blockchain.

Problem Statement: 9

Blockchain is a technology that allows you to trace your drugs transparently. It offers decentralized nodes for the end to end verification to trace the drugs in a transparent manner. This technology is a replacement for traditional drug management systems with distributed, non-repudiation, and security protection characteristics.

Design a smart contract using the Ethereum blockchain where you should be able to track the drugs transparently.

Problem Statement: 10

Blockchain is a technology that allows you to trace your vaccines transparently. It offers decentralized nodes for end-to-end verification to trace the vaccines in a transparent manner.

Design a smart contract using the Ethereum blockchain where you should be able to track the vaccines and you should be able to add the details of the vaccine to the blockchain and should be able to query whenever it is required.

Problem Statement: 11

Blockchain is a technology that allows you to trace data transparently. It offers decentralized nodes for the end to end verification to trace the transportation data in a transparent manner.

Design a smart contract using the Ethereum blockchain where you should be able to track the National and state highways, toll collection, tracking of public infrastructure using the smart contract in the blockchain

Problem Statement: 12

Design a smart contract using the Ethereum blockchain where you track the progress on climate agreement through Blockchain. You should be able to add the confidential details of climate change into the blockchain, should be able to query the details from the blockchain and then change the confidential details whenever it is required.

Problem Statement: 13

Design a smart contract using the Ethereum blockchain where you can add the relevant documents on Micro-financing, and financing small businesses or individuals into the blockchain You should be able to add the financial details into the blockchain, should be able to query the details from the blockchain and then change the financial details whenever it is required.

Problem Statement: 14

Design a smart contract using the Ethereum blockchain where you can add the relevant documents on agriculture data into the blockchain You should be able to add the agriculture product details into the blockchain, should be able to query the details from the blockchain, and then change the details whenever it is required.

Problem Statement: 15

Blockchain is a technology designed to manage farm insurance data that has the potential to support transparency and accountability. A blockchain is a ledger of transactions where an identical copy is visible to all the members of a computer network. Network members validate the data entered into the ledger, and once entered, the data is immutable.

Design a smart contract using the Ethereum blockchain where you can add the farm insurance data into the blockchain You should be able to add details into the blockchain, should be able to query the details from the blockchain and then change the details whenever it is required to change the insurance details whenever it is required.

Problem Statement: 16

Blockchain is a technology designed to manage toll-free data that has the potential to support transparency and accountability. A blockchain is a ledger of transactions where an identical copy is visible to all the members of a computer network. Network members validate the data entered into the ledger, and once entered, the data is immutable.

Design a smart contract using the Ethereum blockchain where you can add the toll-free data into the blockchain You should be able to add details into the blockchain, should be able to query the details from the blockchain and then change the details whenever it is required. You can take all the parameters which you want to store as part of the toll data.

Problem Statement: 17

Blockchain technology is a decentralized, distributed ledger that stores the record of ownership of digital assets. Any data stored on the blockchain is unable to be modified, making the technology a legitimate disruptor for industries like payments, cybersecurity, and healthcare. Discover more about what it is, how it's used, and its history.

Design a distributed ledger via the nodes connected to the chain. You can use any kind of electronic device for the blockchain nodes to maintain copies of the chain network functioning and can create inherent security by giving a unique alphanumeric identification number needed to shows their transactions

Problem Statement: 18

Blockchain is a technology designed to strengthen media industry data that has the potential to deal with data privacy, royalty payments, and piracy of intellectual property. A blockchain can give the industry a much-needed facelift when it comes to data rights, piracy, and payments.

Design a smart contract using the Ethereum blockchain where you can prevent digital assets, from existing in multiple places. You should be able to add details to the blockchain, should be able to preserve ownership, make piracy from the blockchain and then change the details whenever it is required to maintain the data integrity.

Problem Statement: 19

Blockchain is a technology to secure government documents and also improve bureaucratic efficiency, and accountability and reduce massive financial burdens. Blockchain has the potential to revolutionize our elections. Blockchain-based voting could improve civic engagement by providing a level of security and incorruptibility and transparency by recording a public record of all activity.

Design a smart contract using the Ethereum blockchain where you can encrypt a biometric security system making the voting platform an open-source virtual blockchain ballot box. You can take all the parameters which you want to store as part of the ballot data.

Problem Statement: 20

Blockchain is a technology that is designed to manage Non-fungible tokens (NFTs). NFTs are simply digital items, like music, art, GIFs, and videos that are sold on a blockchain, ensuring that a sole owner can claim full rights to them. Consumers can now claim sole ownership over some of the most desirable digital assets for their applications.

Design a smart contract using the Ethereum blockchain where you can add the popular IPs and brand figures into digital collectibles for consumers. You should be able to add an ecosystem into the blockchain, which allows fans and collectors to interact with icons in the form of official licensed digital collectibles.

Books Reference: -

S.No	Blockchain Reference Books
1	Saurabh Kumar and Saxena Ashutosh., 2020." Blockchain Technology: Concepts and Applications" Wiley India Pvt Ltd, First Edition, ISBN-10: 8126557664, ISBN-13: 978-8126557660
2	Arun, Jai Singh & Cuomo, Jerry & Gaur, Nitin., 2019." Blockchain for Business" Pearson Education, First edition, ISBN-10: 938958888X, ISBN-13: 978-9389588880
3	Tulajadas Choudhari, Ambadas & Sarfarz Ariff, Arshad & M.R. Sham., 2020. "Blockchain for Enterprise Application Developers" Wiley, First edition, ISBN-10: 8126599960, ISBN-13: 978-8126599967
4	Subramanian, Chandramouli & George A., Asha & K.A., Abhilash & Karthikeyan, Meena., 2020. "BLOCKCHAIN TECHNOLOGY" Universities Press (India) Pvt. Ltd., First edition, ISBN-10: 9389211638, ISBN-13: 978-9389211634