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Semester: ..... Program: ..... Branch: ..... Specialization: .....

Date: .....

# Applied and Action Learning

(Learning by Doing and Discovery)

**Name of the Experiement :** Build the network – Peer-to-Peer Simulation

## Objective/Aim:

To understand and simulate the structure and communication of a decentralized peer-to-peer (P2P) network, which is fundamental to blockchain systems like Ethereum and Bitcoin

## Apparatus/Software Used:

- Network simulation tools or libraries (e.g., peersim, libp2p)
- MetaMask
- Local test environment or virtual machines for distributed node

## Theory/Concept:

A peer-to-peer network is a decentralized network architecture where each participant (node) functions both as a client and a server, sharing resources and information directly without relying on a central authority. In blockchain, P2P networks enable nodes to collectively maintain and validate the distributed ledger, ensuring transparency, resilience, and immutability.

In a P2P blockchain network, nodes communicate by broadcasting transactions and blocks to peers, propagating data across the network. Consensus protocols operate within this network to agree on the blockchain state. The absence of a central hub prevents single points of failure and censorship.

The simulation of a P2P network demonstrates message propagation, peer discovery, and data synchronization, reflecting core blockchain network operations

## Procedure:

- Set up multiple nodes in the simulation, each capable of sending and receiving messages autonomously
- Implement peer discovery protocols where nodes identify and connect to other nodes
- Simulate message broadcasting where a transaction or block is sent from one node and relayed to peers until all nodes receive it
- Introduce network latency, message loss, or node failures to observe network robustness
- Optionally, implement simple consensus or validation logic to mimic blockchain operations
- Monitor the network to verify successful data propagation and node synchronization

## Observation:

- The P2P network efficiently distributes data by decentralized peer communications
- No single node controls the network; each node contributes to overall robustness and fault tolerance
- Nodes maintain consistent ledger copies by receiving and validating shared data
- The simulation illustrates the resilience and decentralized trust model essential to blockchain technology

| Step | Action | Peer A Status | Peer B Status | Peer C Status | Network State |
|---|---|---|---|---|---|
| 1 | Initial state | ✅ Valid | ✅ Valid | ✅ Valid | All peers synchronized |
| 2 | Modify Block #2 in Peer A | ❌ Invalid | ✅ Valid | ✅ Valid | Peer A out of sync |
| 3 | Mine Block #2 in Peer A | ✅ Valid | ✅ Valid | ✅ Valid | Peer A valid but different data |
| 4 | Manually sync B & C with A | ✅ Valid | ✅ Valid | ✅ Valid | All peers synchronized again |

### ASSESSMENT

| Rubrics | Full Mark | Marks Obtained | Remarks |
|---|---|---|---|
| Concept | 10 | | |
| Planning and Execution/ Practical Simulation/ Programming | 10 | | |
| Result and Interpretation | 10 | | |
| Record of Applied and Action Learning | 10 | | |
| Viva | 10 | | |
| **Total** | **50** | | |

***Signature of the Faculty:***

***Signature of the Student:***

***Name :***

***Regn. No.***