

 **PoW vs PoS – Consensus Mechanism Comparison**  
**Objective/Aim:**

To compare and analyze the working principles, strengths, and limitations of Proof of Work (PoW) and Proof of Stake (PoS) consensus mechanisms, focusing on their security, energy efficiency, scalability, and practical implications in blockchain networks

**Apparatus/Software Used:**

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

**Theory/Concept:**

PoW and PoS are blockchain consensus mechanisms that maintain integrity and agreement across distributed ledgers without a central authority. PoW relies on miners solving cryptographic puzzles using substantial computational resources, providing high security but consuming large amounts of energy. PoS selects validators based on their stake in the network—meaning their ownership of cryptocurrency—offering greater energy efficiency and quicker confirmation times but raising concerns about wealth-based centralization and potential security complexities.



**Procedure:**

* Set up two separate blockchain test environments: one operating under PoW (e.g., Bitcoin/Ethereum pre-merge) and another under PoS (e.g., Ethereum 2.0, Cardano).
* Configure network nodes and deploy smart contracts or initiate test transactions.
* Monitor and record metrics related to block validation time, transaction throughput, energy/resource usage, and network participation.
* Introduce potential adversarial scenarios (e.g., Sybil or double-spend attempts) to assess security robustness.
* Collect and analyze data on network behavior, scalability, decentralization, and validator rewards.

**Observation:**

* PoW-based network shows higher energy consumption and slower transaction confirmation but robust security against attacks due to computational cost
* PoS-based network achieves greater efficiency, faster transactions, and lower environmental impact, but may involve some centralization risks if stake is unevenly distributed among participants.
* Both mechanisms successfully prevent double-spending and maintain consensus but differ significantly in scalability, ecological footprint, and validator selection approach.