

 **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:**

* Simulation or testnet blockchain environments
* Blockchain explorers
* blockchain technical documentation

**Theory/Concept:**

PoW and PoS are blockchain consensus protocols that ensure integrity and agreement on distributed ledgers without the need for central authority. PoW depends on miners cracking cryptographic puzzles with high computational power, ensuring strong security but at high energy expenditure.

PoS chooses validators according to their stake in the network—in other words, their ownership of cryptocurrency—and offers more energy efficiency and faster confirmation times but with the issues of wealth-based centralization and possible security complications.



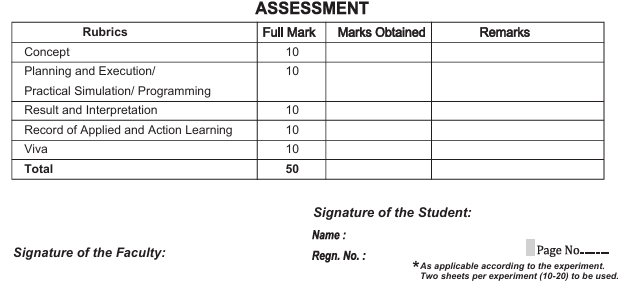
**Procedure:**

* 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.

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