1. Blockchain Basics (100–150 words)

A **blockchain** is like a digital notebook shared by many computers. It stores data in pages called **blocks**, and each block is connected to the previous one — forming a chain. Once something is written in a block, it **can't be changed**, making it very secure. Everyone using this notebook can see what's written, so it's **transparent**.

Instead of one boss or center controlling it, blockchain is run by a **network of people (nodes)**. To add a new block, everyone must **agree** through a method called **consensus** (like voting). If someone tries to cheat, others will spot it and reject the change. Because of this, blockchain is used in areas where **trust, security, and accuracy** are important, like in **money transactions**, **medical records**, or **identity verification**.

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2. Real-Life Use Cases

a.**Supply Chain Management**:
Blockchain tracks the journey of products from factory to store. This helps check if items are **real, fresh, or ethically made**.

b. **Digital Identity**:
People's ID info (like passports or certificates) can be safely stored on a blockchain, making it hard to fake and easy to verify **without needing paperwork**.

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3. Block Anatomy (ASCII version)

Here's a simple diagram of what's inside a block:

```
+--------------------------+
|       Block #1           |
+--------------------------+
| Timestamp: 2025-06-07    |
| Data: {Transactions}     |
| Prev Hash: ab34e...      |
| Nonce: 1023              |
| Merkle Root: d1e2f...    |
| Hash: 009ab...           |
+--------------------------+
```

Each block contains:

- **Timestamp**: When the block was created
- **Data**: Transaction details
- **Previous Hash**: A fingerprint of the block before it
- **Nonce**: A number miners change to solve puzzles
- **Merkle Root**: One combined hash of all transactions
- **Hash**: Unique ID of this block

4. Merkle Root Explanation

A **Merkle Root** is like a tree that summarizes all transactions in a block with just **one final value**.

How it works:

1. Take 4 transactions: Tx1, Tx2, Tx3, Tx4
2. Convert each to a hash: H1, H2, H3, H4
3. Combine pairs: H1+H2 → H12, H3+H4 → H34
4. Combine H12 and H34 → **Merkle Root**

If **any transaction is changed**, the Merkle Root changes.
This helps quickly check if data is **correct** or **tampered with**, without looking at each transaction.

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5. Consensus Concepts (Easy & Brief)

* **Proof of Work (PoW)**
Computers compete to solve a **math puzzle**. The fastest one gets to add the block and earn a reward.
✅ Very secure
❌ Wastes a lot of electricity

* **Proof of Stake (PoS)**
People lock (stake) their coins, and one is chosen (like a lucky draw) to add a block.
✅ Uses less energy
❌ Richer users may have better chances

* **Delegated Proof of Stake (DPoS)**
Users **vote for trusted people** (delegates) to add blocks for them.
✅ Fast and efficient
❌ Can become less decentralized