# Dr.SNS RAJALAKSHMI COLLEGE OF ARTS AND SCIENCE
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Coimbatore- 49

## DEPARTMENT OF COMMERCE WITH INFORMATION TECHNOLOGY

# 21UCI505 – BLOCKCHAIN AND DISTRIBUTIVE LEDGER

## Unit-1: Design Primitives

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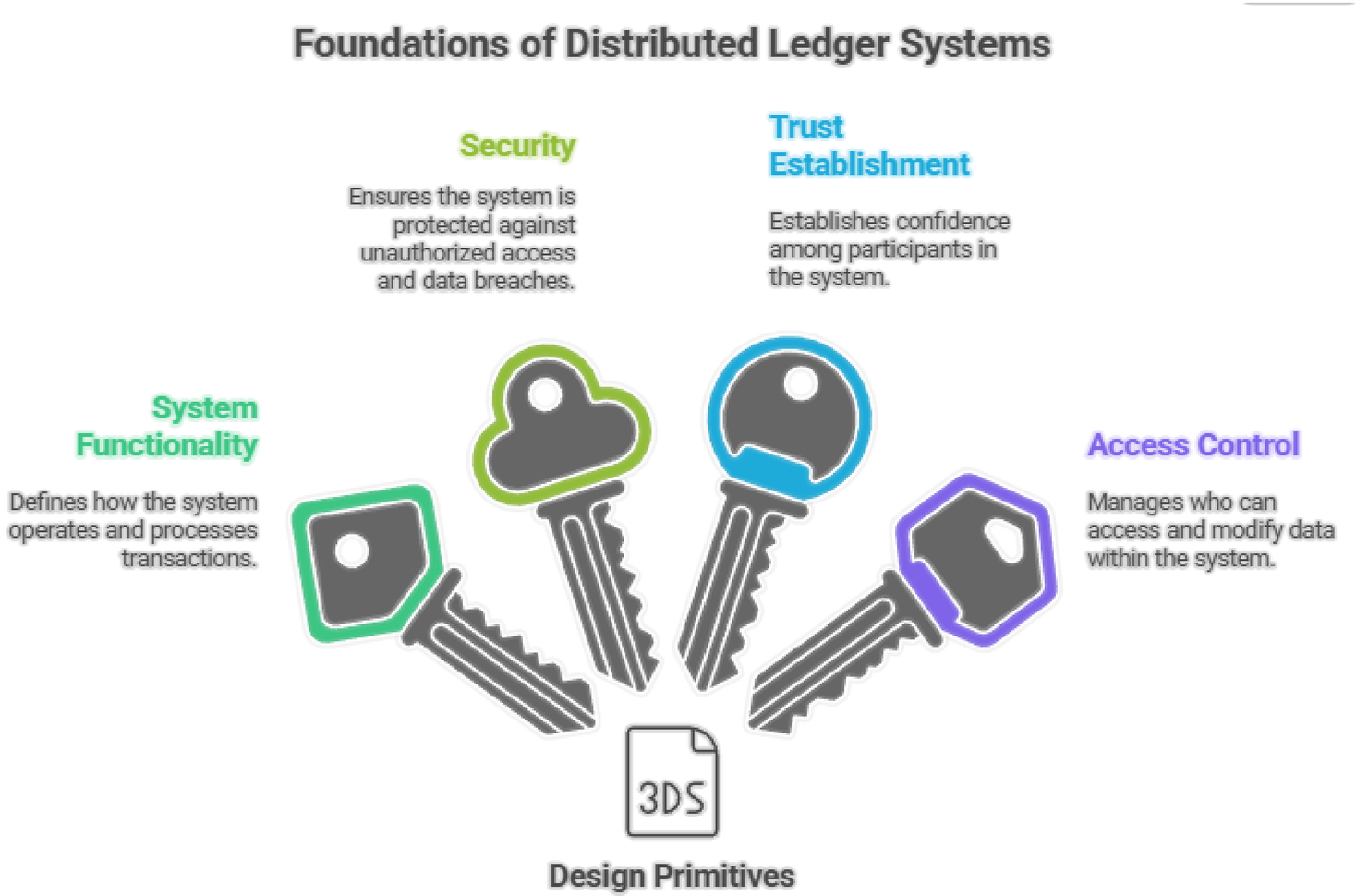
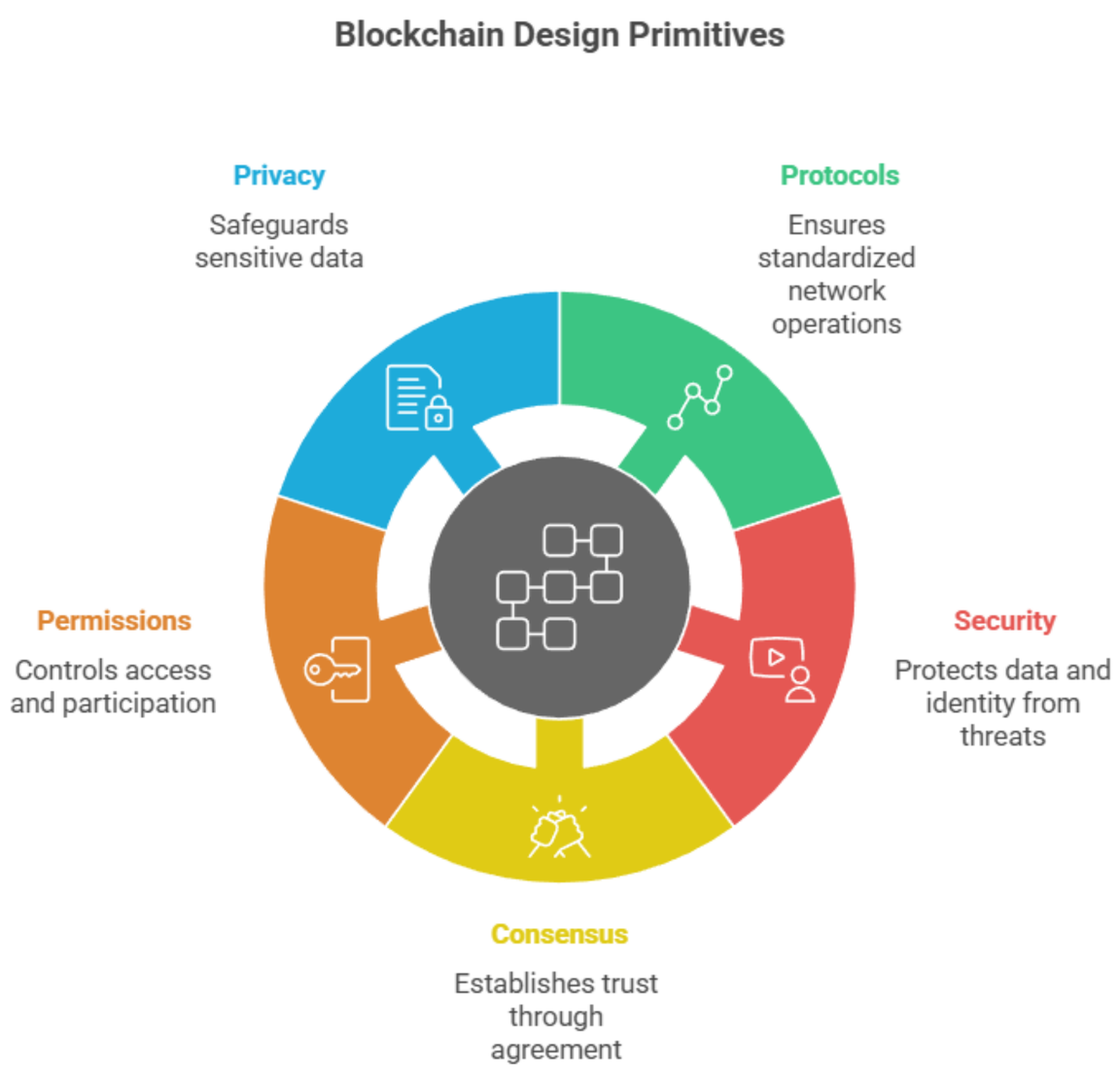
# Introduction to Design Primitives




- fundamental building blocks used to design and operate a distributed ledger or blockchain system.
- define *how the system works, how it stays secure, how trust is established, and who can access what.*

# Components of Design Primitive




1.Protocols

2. Security

3. Consensus

4. Permissions

5. Privacy

# 1. PROTOCOLS

**Meaning:**

Protocols are the **rules and procedures** that define how the distributed ledger operates.

**What they include:**

- How nodes communicate
- How transactions are formatted
- How blocks are created & added
- How data is synchronized across nodes

**Example:**

Bitcoin protocol, Ethereum protocol, Hyperledger Fabric architecture.

**Purpose:**

Ensures **standardization and smooth coordination** among all participants.

# 2. Security

**Meaning:**

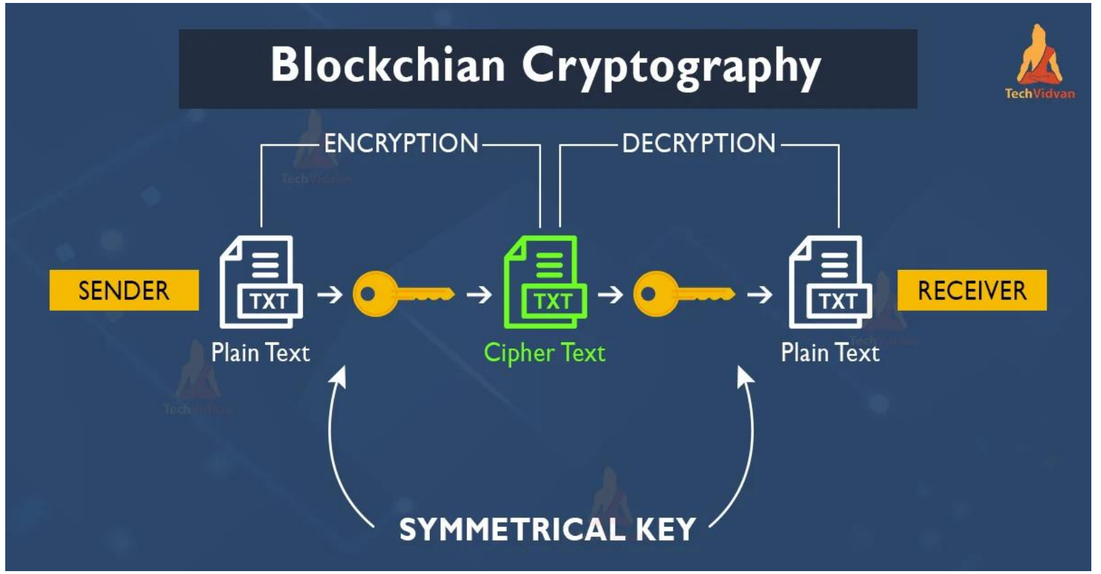
Security primitives protect the ledger from **hacking, fraud, unauthorized access, and data tampering**.

**Key security tools:**

- Cryptography (public & private keys)
- Hashing (e.g., SHA-256)

**Digital signatures**

- Immutability of blocks
- Encryption




**Purpose:**

- ✓ Ensures transactions are **authentic, safe, and tamper-proof**.
- ✓ No one can alter recorded data.

# 3. Consensus

**Meaning:**

Consensus is the **mechanism through which all nodes agree** on the validity of transactions.

**Why it is needed:**

- ✓ There is no central authority in DLT.
- ✓ Consensus maintains a single version of truth.

**Common Consensus Algorithms:**

- Proof of Work (PoW) – Bitcoin
- Proof of Stake (PoS) – Ethereum 2.0
- PBFT (Practical Byzantine Fault Tolerance) – permissioned networks
- Proof of Authority (PoA) – enterprise systems

**Purpose:**

Prevents-

- Double spending
- Fraud
- Conflicts between nodes
- Invalid transactions

# 4. Permissions

**Meaning:**

Permissions define who can join the ledger, what they can view, and what actions they can perform.

**Types:**

**1. Permissionless (Public) Blockchain**

Anyone can join, read, and write. Example: Bitcoin, Ethereum.

**2. Permissioned (Private/Consortium) Blockchain**

Only approved members can join.

Used by banks, companies, and government. Example: Hyperledger Fabric.

**Purpose:**

Ensures controlled access, confidentiality, and compliance based on organization requirements.

# 5. Privacy

Privacy primitives ensure that sensitive information is protected, even in a decentralized and transparent system.

**Tools Used:**

**Zero-knowledge proofs (ZKP)**

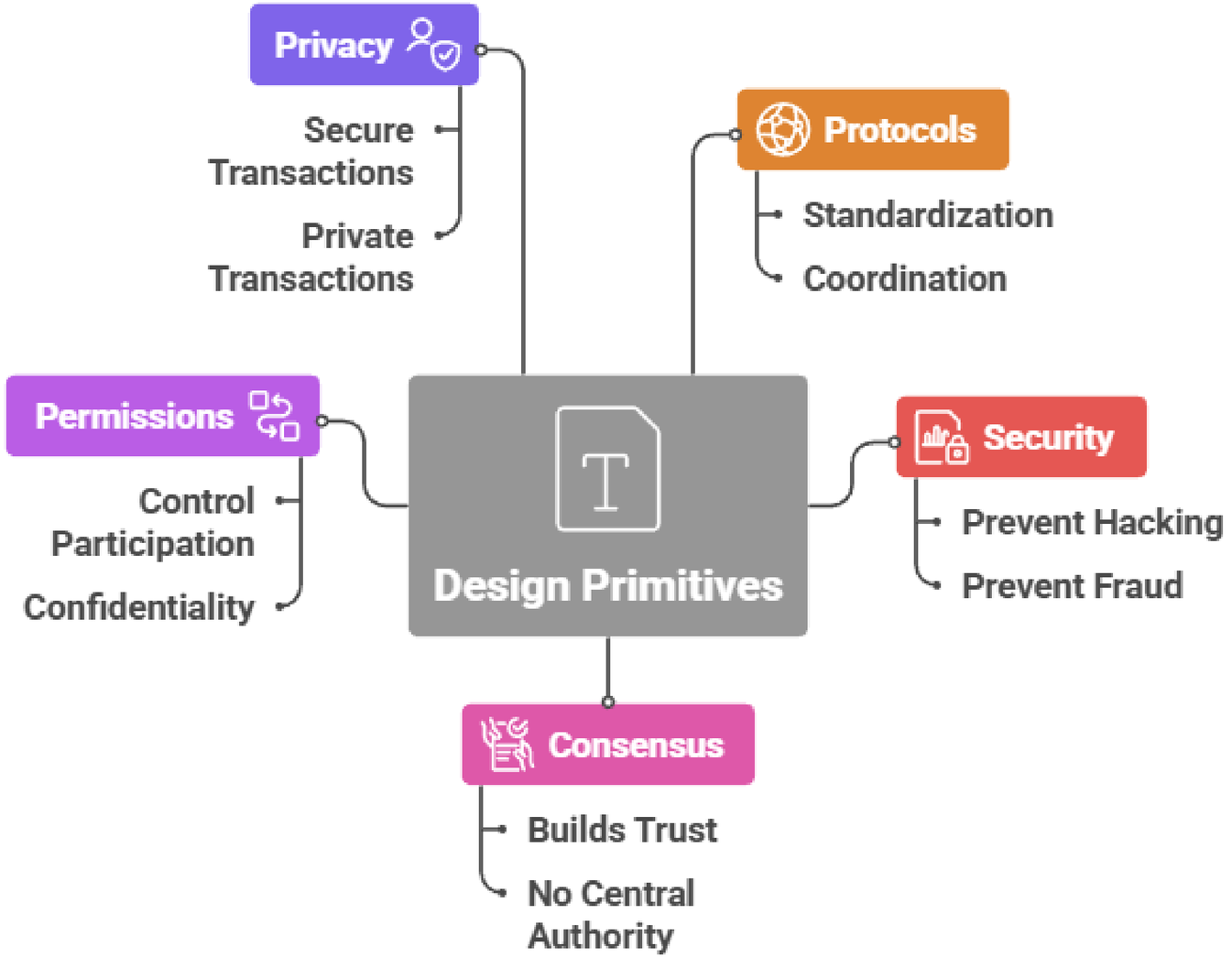
- Private channels (Hyperledger)
- Data encryption
- Off-chain data storage

**Purpose:**

Protects:

- Customer data
- Business secrets
- Transaction details
- Regulatory compliance (e.g., GDPR, banking regulations)

# Design Primitives in Decentralized Systems



# Assessment Questions & Answers

What is the mechanism nodes use to agree on a single version of truth?

Consensus

What are the rules that define how a distributed ledger operates?

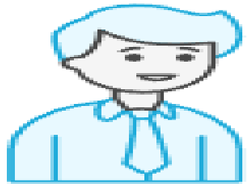
Protocols

What is the technique that protects data using keys and hashing?

Security

What control decides who can join or access a blockchain network?

Permissions



# THANK YOU