KARNAVATI UNIVERSITY

Operating Systems

Course Code: **71203002004**

Disk Structure

by -

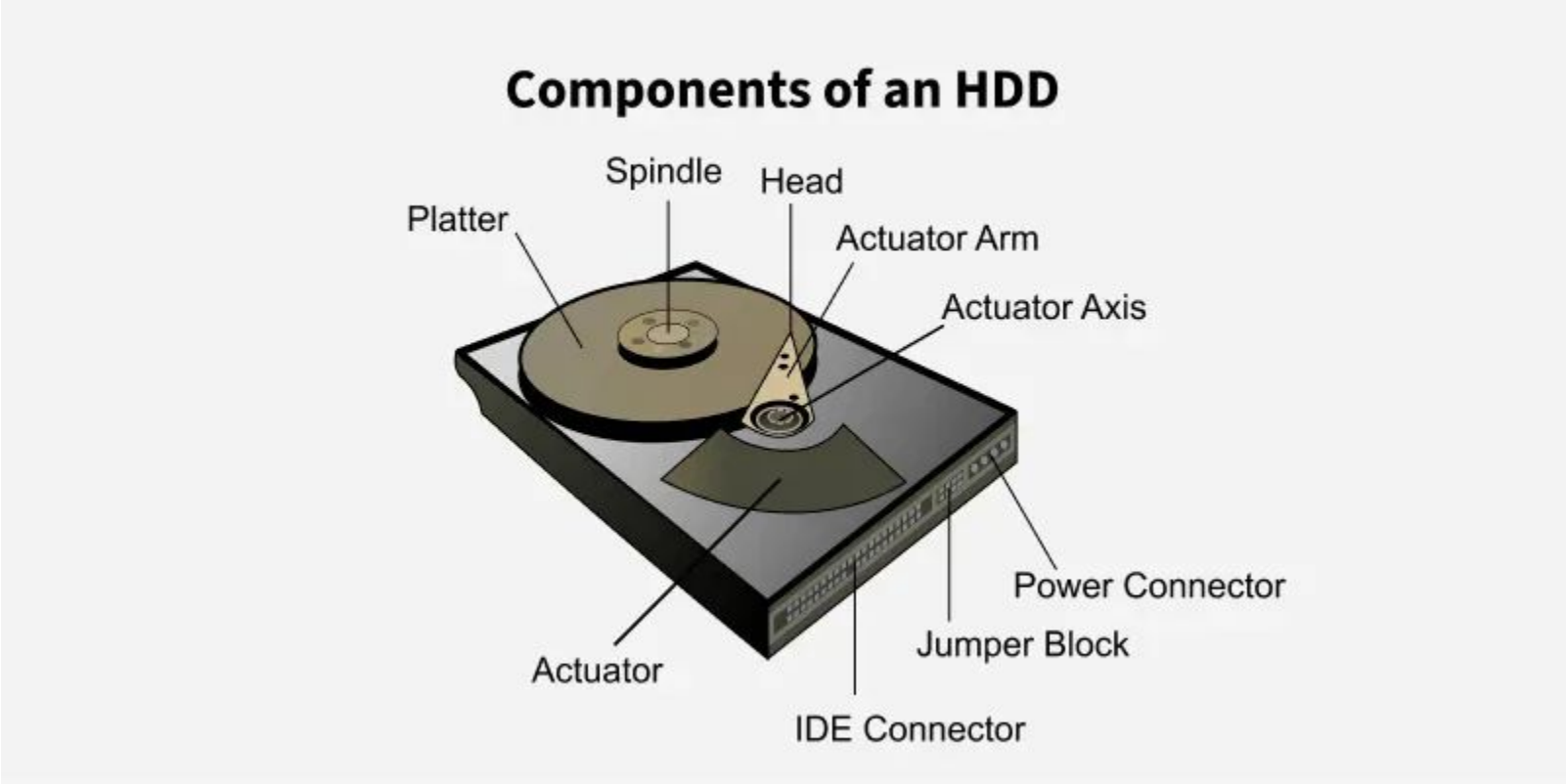
Minal Rajwar

Introduction to Hard Disk Drive (HDD)

Definition:
A hard disk drive (HDD) is a *non-volatile storage device* that uses magnetic technology to store and retrieve data permanently (even after power off).

Purpose:
Used for storing operating systems, applications, and user data.

Key Idea:
Data is stored in sectors on rotating platters, and accessed by read/write heads.
Some space in each sector is reserved for formatting, so usable capacity is slightly less than total capacity.


Components of an HDD
Spindle
Head
Platter
Actuator Arm
Actuator Axis
Power Connector
Jumper Block
Actuator
IDE Connector

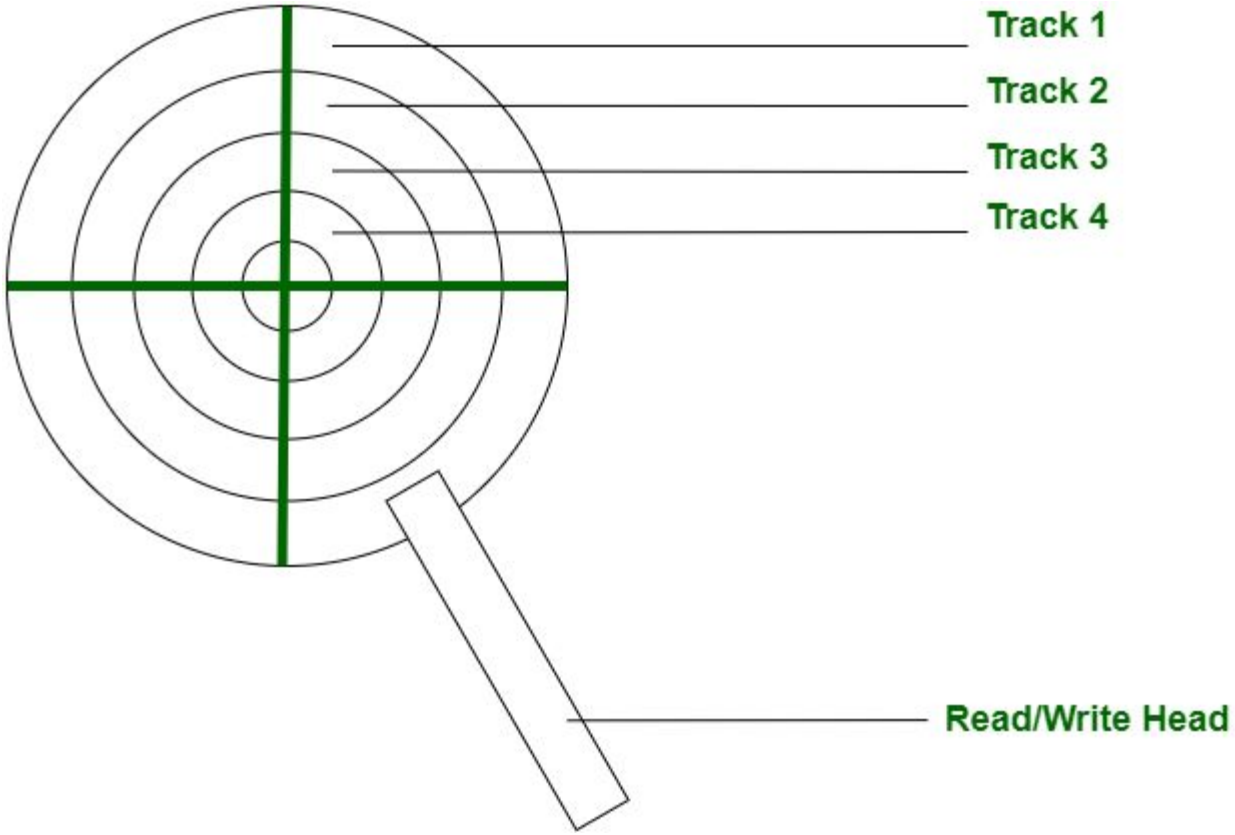
Physical Structure of Disks

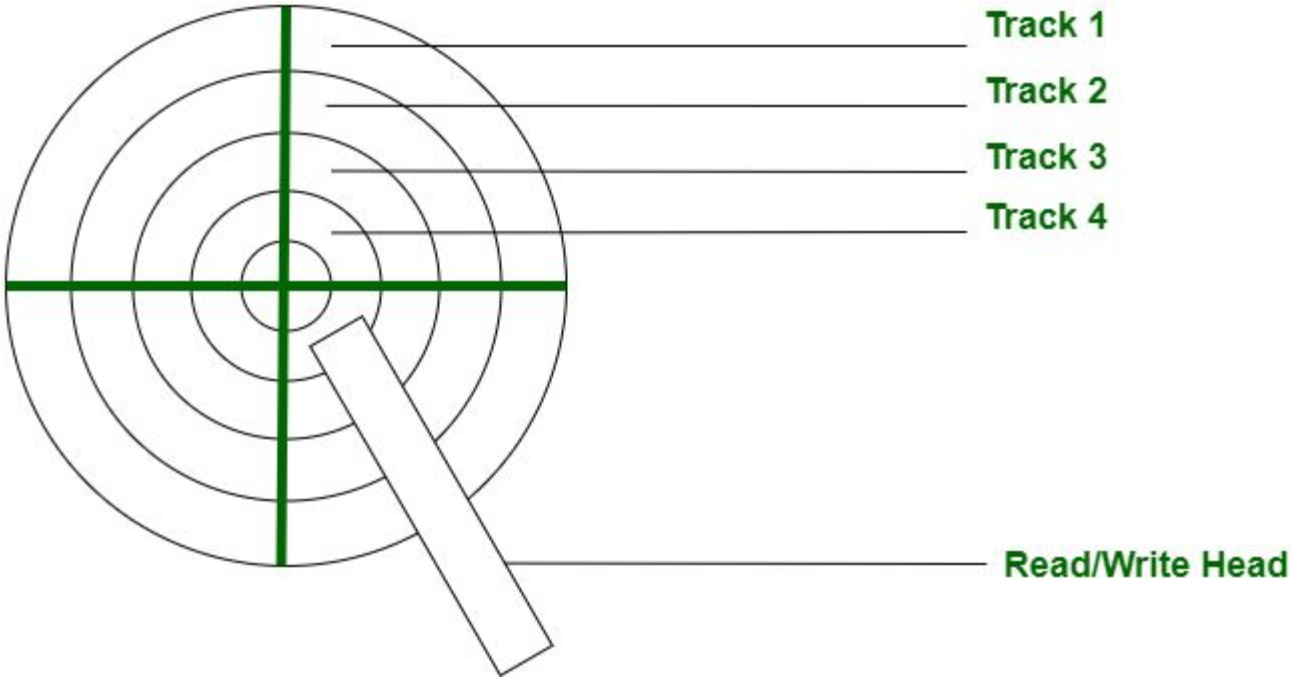
Component	Description
Platters	Circular disks (made of aluminium or glass) coated with magnetic material. They store data. Multiple platters are mounted on a spindle.
Spindle	Rotates the platters at high speed (measured in **RPM**). Higher RPM → faster read/write.
Read/Write Head	Performs the actual reading/writing of data from the platter surface.
Actuator Arm	Moves the head precisely over tracks to access specific data locations.
Tracks & Sectors	Each platter surface is divided into **tracks** (concentric circles), and each track is divided into **sectors** (small data blocks).

Disk Access Parameters

Seek Time

- Time taken by the read/write head to move from one track to another.
- Formula:
  Seek Time = (No. of tracks crossed) × (Time to cross one track)
- Example: Moving head from track 1 → 4.
- Lower seek time = faster data access.


Track 1
Track 2
Track 3
Track 4
Read/Write Head



Reading Track 4

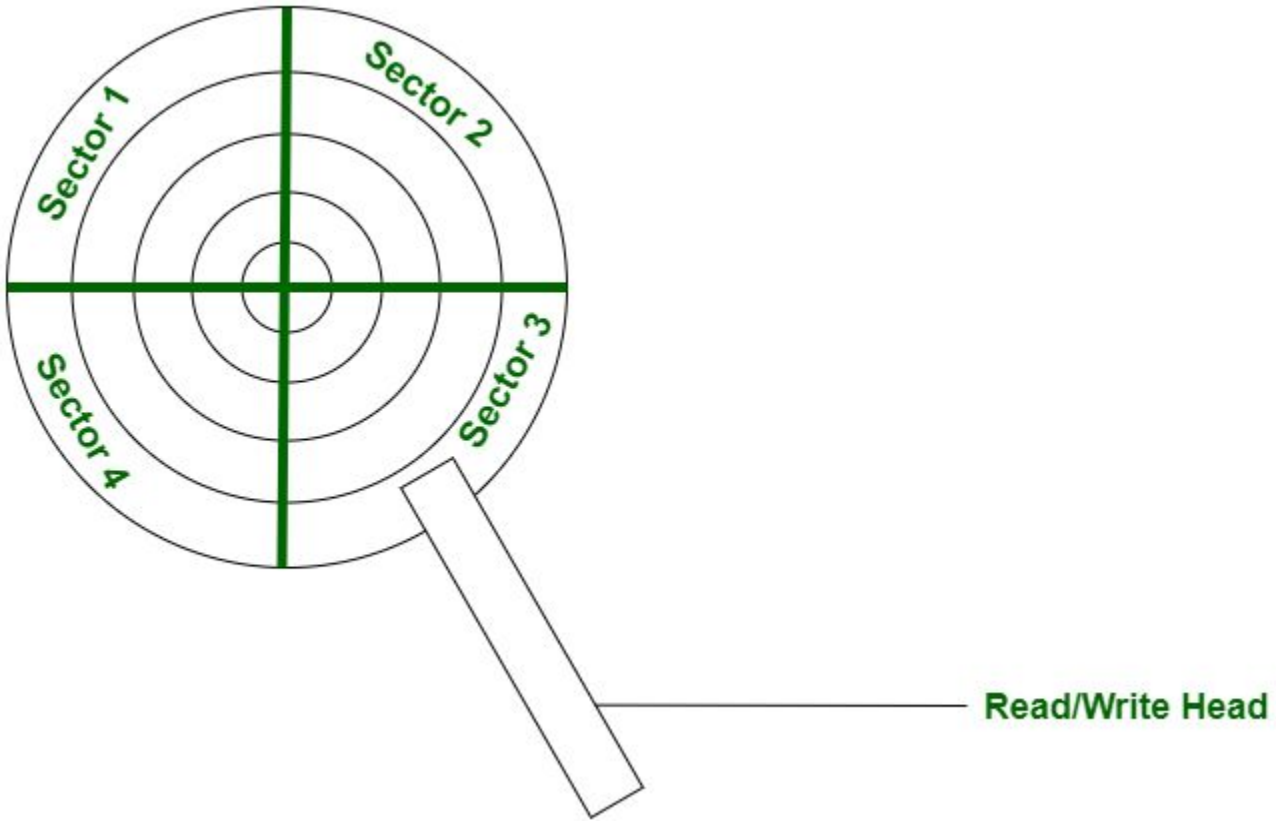
Disk Access Parameters

Rotational Latency

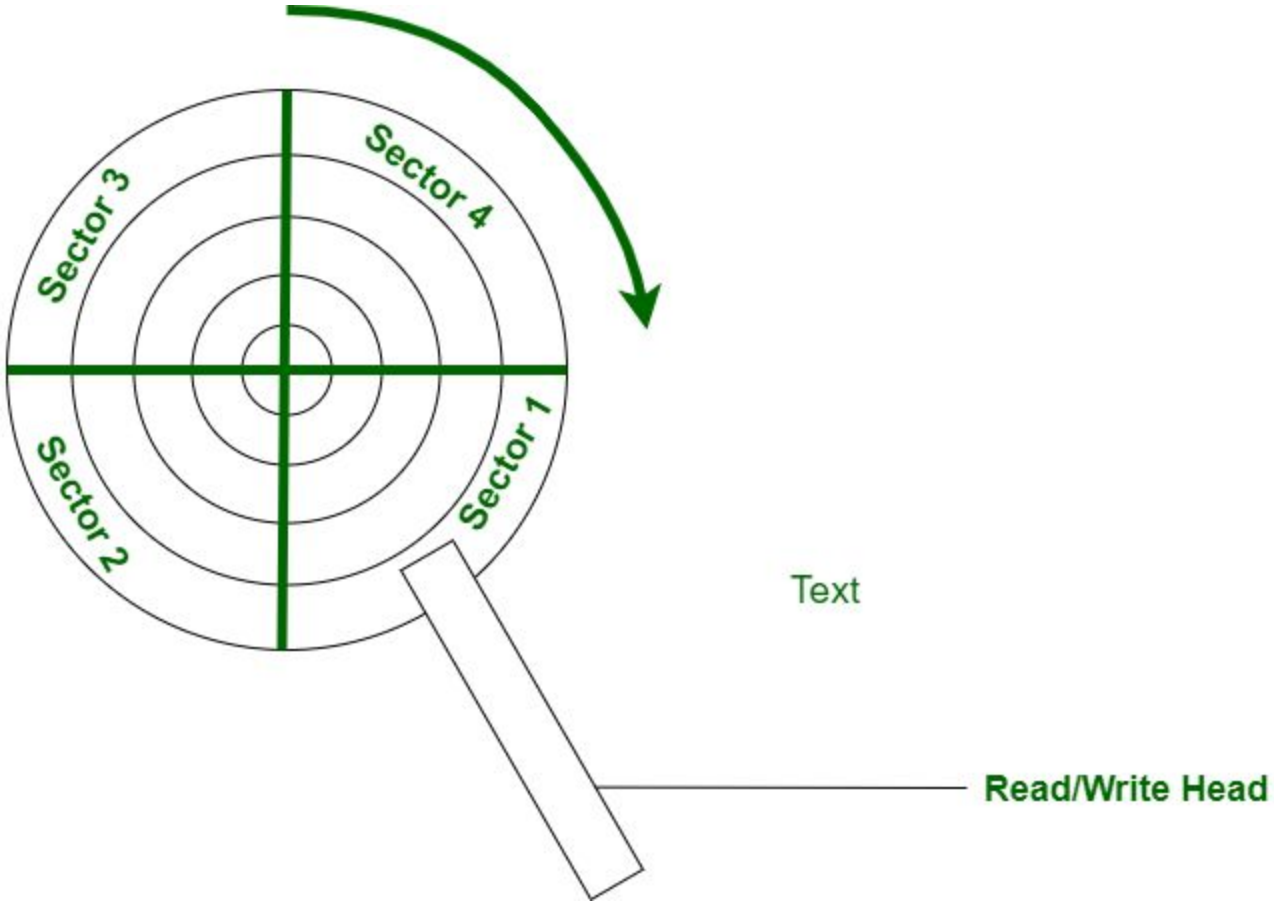
- Time for the disk to rotate the required sector under the head.
- Formula:
  Rotational Latency = (Angle to rotate) / (Rotational Frequency)
- Depends on disk speed (RPM).

Disk Access Time

- Total time to read/write data from disk.
- Formula:
  Disk Access Time = Access Time + Data Transfer Time



Rotational Latency



The data block may be present in sector 1. The time required by read/write head to move from sector 3 to sector 1 is the **rotational latency**.

Disk Access Parameters

Where:

- Access Time = Seek Time + Rotational Latency + Command Processing + Settle Time
- Data Transfer Time = time to move data (internal: between disk & cache, external: between cache & system).

Transfer Rate

- Internal Transfer Rate: Disk surface ↔ Disk cache
- External Transfer Rate: Disk cache ↔ Computer system
- Determines how quickly data moves once accessed.

Disk Addressing Methods

1. CHS (Cylinder-Head-Sector) Addressing

- Early method to locate data.
- Data addressed by specifying:
    - Cylinder (Track) number
    - Head number
    - Sector number
- Example: (Cylinder 3, Head 2, Sector 5)

Disk Addressing Methods

2. LBA (Logical Block Addressing)

- Modern method used by most OS and drives.
- Treats disk as a continuous array of blocks, each with a unique number (Block 0, Block 1, Block 2...).
- Hides the physical details (tracks, heads, sectors).
- Simplifies data management and improves compatibility.

💡 **Example:**

CHS = (Cylinder 1, Head 0, Sector 3) → LBA = Block 63

DISCUSSION & REVISION

1. The circular magnetic disks used to store data in an HDD are called _____.
2. The time taken by the read/write head to move from one track to another is called _____.
3. The time taken for the desired sector to rotate under the read/write head is called _____.
4. The modern method of addressing disk sectors using block numbers is called _____.
5. The speed at which data is transferred between the disk and the system is called _____.

REFERENCES

1. https://www.geeksforgeeks.org/computer-organization-architecture/hard-disk-drive-hdd-secondary-memory/
2. https://www.geeksforgeeks.org/operating-systems/difference-between-seek-time-and-disk-access-time-in-disk-scheduling/
3. https://www.geeksforgeeks.org/operating-systems/difference-between-seek-time-and-rotational-latency-in-disk-scheduling/