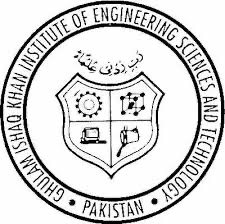
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**DATA SCIENCE**

**Q1: Data Redundancy**

**Data Redundancy** refers to storing the same piece of data in multiple places unnecessarily.  
**How Databases Reduce Redundancy:**

* **Centralized Storage:** Databases store data in a single location accessible to all users.
* **Normalization:** Techniques like splitting tables and using relationships eliminate duplicate data.

**Q2: DBMS Catalog**

DBMS Catalog  is a metadata repository storing details about the database structure.  
**Role in Database Management:**

* Tracks schema definitions, access permissions, and storage details.
* Enables the DBMS to enforce data integrity and optimize queries.

**Q3: Advantages of DBMS over File-Based Systems**

1. **Data Integrity:** Constraints prevent invalid data.
2. **Concurrency Control:** Multiple users can access data simultaneously without conflicts.
3. **Security:** User roles and permissions restrict unauthorized access.
4. **Backup & Recovery:** Automated tools restore data after failures.
5. **Data Independence:** Changes in storage (physical) or structure (logical) do not affect applications.

**Q4: Relational Data Model Components**

1. **Tables (Relations):** E.g., a "Students" table.
2. **Rows (Tuples):** A single student record (e.g., StudentID=101, Name="Ali").
3. **Columns (Attributes):** Fields like "StudentID" or "Name".
4. **Keys:**
   * **Primary Key:** Unique identifier (e.g., StudentID).
   * **Foreign Key:** Links tables (e.g., "CourseID" in "Enrollments" referencing "Courses").
5. **Constraints:** Rules (e.g., NOT NULL, UNIQUE).

**Q5: Three-Level Architecture & Data Independence**

* **Logical Data Independence:** Changes to the conceptual schema (e.g., adding a "Phone" column) do not affect external/user views.  
  Example: Users still see their existing queries without modification.
* **Physical Data Independence:** Changes to the internal schema (e.g., indexing) do not affect the conceptual schema.  
  Example: Switching from HDD to SSD storage requires no changes to table structures.

**Q6: Storage Structure Changes & Three-Level Architecture**

Changing the storage structure (e.g., indexing, file organization) affects only the **Internal Level**. The Conceptual and External Levels remain unchanged due to **Physical Data Independence**.

**Q7: Banking System & Three-Level Architecture**

* **External Level:** Customized views for customers (balance checks), tellers (transaction processing), and managers (reports).
* **Conceptual Level:** Unified schema defining all data (e.g., accounts, transactions).
* **Internal Level:** Storage details (e.g., disk allocation).  
  **Management:** Changes to a user’s view (External Level) do not impact the overall database design (Conceptual/Internal Levels).