1. **Components of a Database:**

a) **Stored Procedures (2 Marks):** Stored procedures are precompiled SQL queries or programs that are stored in a database. They consist of a set of SQL statements and procedural logic. Key points about stored procedures include:

* + They are stored in the database for reuse and efficient execution.
  + They help in improving performance by reducing network traffic and promoting code reusability.

b) **Tables (2 Marks):** Tables are fundamental components of a relational database. They organize and store data in rows and columns. Key points about tables include:

* + They define the structure of the database by specifying fields, data types, and relationships.
  + Each table typically represents an entity, and each row represents a record or instance of that entity.

c) **Triggers (2 Marks):** Triggers are sets of instructions that automatically execute in response to specific events in the database. Key points about triggers include:

* + They are associated with tables and are triggered by events like INSERT, UPDATE, DELETE, etc.
  + Triggers are used to enforce business rules, maintain data integrity, and automate certain tasks.

1. **Functions in a Database Management System:**

a) **Data Manipulation Language (2 Marks):**

* + DML is a subset of SQL used for manipulating data within the database.
  + It includes operations such as SELECT, INSERT, UPDATE, and DELETE.
  + DML allows users to interact with and modify the data stored in the database.

b) **Data Definition Language (2 Marks):**

* + DDL is used to define and manage the structure of the database.
  + It includes commands like CREATE, ALTER, and DROP to define tables, relationships, and constraints.
  + DDL focuses on the overall architecture of the database.

1. **Components of a Database Management System (4 Marks):**
   * Database Engine: Manages data storage, retrieval, and manipulation.
   * Query Processor: Translates SQL queries into executable plans.
   * Data Dictionary: Stores metadata about the database structure.
   * Transaction Management: Ensures ACID properties in database transactions.
2. **ACID in Database Management System (2 Marks):** ACID stands for Atomicity, Consistency, Isolation, and Durability. It ensures the reliability of database transactions:
   * **Atomicity:** Transactions are treated as atomic units, either fully completed or fully rolled back.
   * **Consistency:** Transactions bring the database from one consistent state to another.
   * **Isolation:** Transactions operate independently of each other.
   * **Durability:** Once a transaction is committed, its changes are permanent.
3. **Active vs. Passive Data Dictionaries (2 Marks):**
   * **Active Data Dictionary:** Automatically updates and reflects changes made to the database structure.
   * **Passive Data Dictionary:** Requires manual updates and may not reflect real-time changes.
4. **Professionals for Database Application Implementation (6 Marks):**
   * Database Administrator (DBA): Manages database systems, ensures performance, security, and data integrity.
   * Data Analyst: Analyzes and interprets data, designs database structures, and ensures data quality.
   * Database Developer: Creates, tests, and implements database solutions based on application requirements.
5. **Issues with Data Duplication (4 Marks):**
   * **Inconsistency:** Conflicting data may arise if duplicated information is updated in one place but not another.
   * **Data Redundancy:** Increased storage requirements and potential for inconsistencies.
6. **Characteristics of a Well-Defined Database System (4 Marks):**
   * **Data Integrity:** Ensures accuracy, consistency, and reliability of data.
   * **Security:** Implements measures to protect data from unauthorized access and manipulation.
   * **Scalability:** Adapts to changing requirements and can handle increased data volume.
   * **Maintainability:** Easily upgradable, with efficient backup and recovery mechanisms.
7. **Merits of a Distributed Database (4 Marks):**
   * **Improved Performance:** Distributing data across multiple locations reduces query response times.
   * **Increased Availability:** Redundancy and replication enhance system availability.
   * **Scalability:** Can easily scale by adding more nodes or locations.
   * **Fault Tolerance:** Resilient to system failures as data is distributed.
8. **Disadvantages of File-Based System (4 Marks):**
   * **Data Redundancy:** Duplication of data across files leads to inconsistency.
   * **Data Dependency:** Changes in data representation require modifying all programs using that data.
   * **Data Isolation:** Lack of central control may result in data being isolated in different files.
   * **Security Issues:** Limited access controls and increased risk of data breaches.

**1. Preventive Mechanisms of Data and Information within a Database System:**

a) The five preventive mechanisms are:

1. **Access Control:** Implementing proper access controls ensures that only authorized users can access and modify sensitive data. This includes user authentication, role-based access control, and encryption of data during transmission.
2. **Data Encryption:** Encrypting sensitive data helps protect it from unauthorized access. This ensures that even if unauthorized users gain access to the database, they cannot make sense of the encrypted information without the appropriate decryption keys.
3. **Regular Backups:** Regularly backing up the database is crucial for data recovery in case of accidental deletion, corruption, or other unforeseen events. These backups should be stored securely and tested for restoration periodically.
4. **Data Integrity Checks:** Implementing integrity constraints, such as unique key constraints and referential integrity, helps maintain the accuracy and consistency of data within the database. This prevents the entry of invalid or inconsistent data.
5. **Firewalls and Network Security:** Protecting the database system from external threats involves using firewalls and other network security measures. This prevents unauthorized access and potential attacks from malicious entities.

**b) SQL Statements:**

i) Display all records from the fields fname, lname, and department.

SELECT fname, lname, department FROM Employee;

ii) Display all records whose position is clerk.

SELECT \* FROM Employee WHERE position = 'Clerk';

iii) Arrange all records in descending order based on employee salary.

SELECT \* FROM Employee ORDER BY salary DESC;

iv) Display all records for employees who belong to the finance department.

SELECT \* FROM Employee WHERE department = 'Finance';

v) Display all employees whose first name starts with the letter R.

SELECT \* FROM Employee WHERE fname LIKE 'R%';

**2. Database Normalization:**

a) **Normalization Definition:** Normalization is the process of organizing data in a database to reduce redundancy and dependency by organizing data into related tables. 1NF, 2NF, and 3NF are progressively stricter normalization forms.

b) **Benefits of Normalization:**

* **Reduced Data Redundancy:** Normalization eliminates redundant data, reducing storage space and ensuring data consistency.
* **Improved Data Integrity:** Normalization reduces anomalies, ensuring data integrity by preventing insertion, update, and deletion anomalies.
* **Enhanced Query Performance:** Well-normalized databases often result in improved query performance due to efficient data retrieval.
* **Simplified Data Maintenance:** Updates and modifications are easier to perform in a normalized database, leading to simplified data maintenance.

c) **Normalized Table:**

i) **1NF:**

sqlCopy code

CREATE TABLE Student\_1NF ( StudentName VARCHAR(50), DOB DATE, CourseTitle VARCHAR(50), Grade VARCHAR(2) );

ii) **2NF:**

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CREATE TABLE Student\_2NF ( StudentName VARCHAR(50), DOB DATE, CourseID INT, Grade VARCHAR(2) ); CREATE TABLE Course ( CourseID INT PRIMARY KEY, CourseTitle VARCHAR(50) );

iii) **3NF:**

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CREATE TABLE Student\_3NF ( StudentID INT PRIMARY KEY, StudentName VARCHAR(50), DOB DATE, Grade VARCHAR(2), CourseID INT, FOREIGN KEY (CourseID) REFERENCES Course(CourseID) );

**3. Constraints in Database Management System:**

a) **Benefits of Constraints:**

* **Data Integrity:** Constraints ensure that data entered into the database meets specified criteria, maintaining data integrity.
* **Enforced Business Rules:** Constraints enforce business rules at the database level, preventing the violation of predefined rules.

b) **Three Levels of Database Design:**

1. **Conceptual Design:** Defines the overall structure of the database, including entities, relationships, and high-level attributes.
2. **Logical Design:** Translates the conceptual design into a logical structure, including tables, columns, and constraints.
3. **Physical Design:** Specifies how data is stored on the hardware, addressing performance and optimization.

c) **ER Diagram to Relational Schema:**

* The ER diagram needs to be provided to create a relational schema accurately.

**4. Factors before Implementing a Database Management System (DBMS):**

a) **Considerations before Implementing a DBMS:**

* **Scalability:** Ensure the DBMS can handle growth in data and user load.
* **Data Security:** Assess the DBMS's security features to protect sensitive information.
* **Cost:** Evaluate the total cost of ownership, including licensing, maintenance, and training.
* **Compatibility:** Ensure compatibility with existing systems and technologies.

b) **Functional Dependencies:**

i) **Partial Dependency:** When a non-prime attribute is dependent on only part of the primary key.

ii) **Transitive Dependency:** When an attribute is dependent on another non-prime attribute.

c) **Employee Details at Semaj Company:**

* **Update Anomalies:** Updating the department name of a manager would require multiple updates.
* **Deletion Anomalies:** Deleting an employee may result in the loss of information about a department.
* **Insertion Anomalies:** Inability to insert information about a department without an associated employee.

These anomalies can be addressed by normalizing the table.

This response covers the requested information. If you have any further questions or need clarification, feel free to ask.