1. Introduction to databases
   Sub-topics:
   a. Database Management Systems benefits

2. SQL
   Sub-topics:
   a. SELECT…FROM… WHERE… framework
   b. DISTINCT keyword
   c. ORDER BY
   d. Aggregate operators: COUNT, MIN, MAX, AVG, SUM
   e. GROUP BY… HAVING
   f. Subqueries
   g. Joins (select from multiple tables)

3. The Relational Model
   Sub-topics:
   a. Relation /Table
      • Attributes
   b. Integrity Constraints
   c. Keys
   d. Primary key
   e. Candidate key
   f. Surrogate key
   g. Foreign key
      • Referential integrity constraint

4. Normalization
   Sub-topics:
   a. Purpose
   b. Insert /delete/update anomalies
   c. Functional dependencies
      • Definition of key based on functional dependencies
   d. Normal forms
      • First normal form
      • Second normal form
      • Third normal form
      • Boyce-Codd Normal Form
      • Decomposition into relations that are in Boyce-Codd Normal Form
e. Multivalued dependencies (not required for exam)
   • Fourth Normal Form

5. Data Modeling with the Entity-Relationship Model

Sub-topics:
a. Entities
   • Identifiers /Composite identifiers
   • Attributes
   • Strong entities
   • Weak entities
   • Id-dependent entities
b. Relationships
   • Has-A relationships
     Maximum and minimum cardinality
     Identifying/non-identifying relationships
   • Is-A relationships (supertype/subtype)
     Inclusive/Exclusive

6. Transforming ER diagrams to Relational Model

Sub-topics:
a. Transform entities
   • Specify primary key
   • Specify candidate (alternate keys)
   • Specify properties for each column
     1. data type
     2. null/not null
     3. default values
     4. other constraints
b. Transform relationships (foreign keys used here)
   • 1:1 relationships, 1:N relationships
     - identifying relationships
     - non-identifying relationships
   • N:M relationships
   • Supertype/subtype relationships
c. Specify logic to enforce minimum cardinalities
d. SQL:
   • CREATE
   • DROP
   • ALTER
   • INSERT
   • DELETE
7. PHP
   a. variables, constants, arrays (numerically indexed arrays and associative arrays)
   b. control statements (if, for, foreach, while, …)
   c. files
   d. functions
   e. objects/classes, inheritance
   f. Work with MySQL using PHP
      - Connect to a database
      - Query
      - process results
      - close connection
   g. Session variables

8. Stored Procedures
   a. A stored procedure is a program that performs some common action on database data and is stored in the database.
   b. Advantages of stored procedures
   c. How to write a stored procedure

9. Triggers
   a. A trigger is a stored program that is attached to a table or view.
   b. Type of triggers
   c. Uses for triggers
   d. Writing a trigger
   e. Differences between triggers and stored procedures

10. SQL VIEWS
    a. SQL View is a virtual table that is constructed from other tables or views.
    b. Syntax: CREATE VIEW viewname AS viewquery
    c. Order By clause cannot be used in the Create View query.
    d. A view can be queried as if it is a table.
    e. Uses for views
    f. Updating views

11. More SQL SELECT
    a. using JOIN .. ON syntax
    b. left join, right join
    c. Sub-queries:
       - Non-correlated sub-queries
       - Correlated sub-queries

12. Database security
a. Create users  
b. Grant/revoke permissions  
c. Storing and checking passwords  
d. SQL-injections  
e. General security guidelines

13. Concurrent processing  
a. Transactions  
b. Concurrent transaction processing  
   - Lost Updates  
   - Inconsistent read  
     1. Dirty read  
     2. Unrepeatable read  
     3. Phantom read  
c. Resource locking  
   - Exclusive/ shared locks  
   - Serializable transactions  
   - Two-phase locking, String two-phase locking  
   - Deadlocks  
     1. preventing deadlocks  
     2. breaking deadlocks  
   - Using implicit locks/ declaring transaction boundaries  
   - ACID transactions  
     1. Atomic  
     2. Consistent  
        a. statement level  
        b. transaction level  
     3. Isolation  
        a. read uncommitted  
        b. read committed  
        c. repeatable read  
        d. serializable  
     4. Durable

14. Storage and indexing  
a. Hash index /B+Tree index  
b. Clustered / unclustered index  
c. How to choose indexes to improve performance

15. Ethics:  
a. The code of professional responsibility  
b. Data misuse – LEADS case