[Answer Any Five Questions]
[Sequence must be maintained in answering each question]

1. a) Define *Database*. Briefly describe the different types of *database languages*. 3
   b) Write down the comparison between *client/server* and *distributed database* system. 2
   c) The people's Bank offers five type of accounts: Loan, checking, premium savings, daily 4
   interest saving, and money market. It operates a number of branches and a client of bank can
   have any number of accounts. Accounts can be joint i.e., more than one client may be able to
   operate a given accounts.
      I.   Account includes Account-No, Account-type, Balance.
      II.   Client includes Name, Age, Address.
      III. Branch includes Branch-ID, Branch-Name, Branch-Address
      IV.   Transaction includes Transaction-ID, Amount, Date, Type.
   Relationships are Account-Branch, Account-Transaction, Account-Client. Now, Draw the
   corresponding *Entity-Relationhip (E-R)* diagram.
   d) How are one-to-one, one-to-many and many-to-many relationships implemented in an 3
   RDBMS?

2. The relational tables represent a university database schema.

   classroom (building, room_number, capacity)
   department (dept_name, building, budget)
   course (course-id, title, dept_name, credits)
   instructor (ID, name, dept_name, salary)
   section (course-id, sec-id, semester, year, building, room number, time_slot_id)
   teaches (ID, course-id, sec-id, semester, year)

   a) Consider the following relational tables for a university database and write down the 6
   appropriate *Relational Algebra* expression for the following queries
      I.   Find the instructors from ICT department with a salary greater than 60,000.
      II.   Determine the list of all instructors who taught at least one course.
      III. Find all the courses taught in the Fall 2017 semester but not in Spring 2018 semester.
      IV.   Finds about course information taught by instructors in the Physics department.
   b) Consider the following relational tables for a university database and write down the 6
   appropriate *SQL* commands for the following queries.
      I.   Retrieve the names of all instructors, along with their department names and
            department building name.
      II.   Increase the salary of each instructor in the ICT department by 10%.
      III. Find the set of all courses taught either in Fall 2017 or in Spring 2018, or both.
      IV.   Find the names of the department where the average salary of the instructor is
            greater than 50000 BDT.

3. a) Define *functional dependency*. Write short notes on *Multivalued functional dependency* and 4
   Transitive functional dependency.
   b) Consider a relation R (A , B , C , D , E) with the *functional dependencies*- 4
      $A \rightarrow BC, CD \rightarrow E, B \rightarrow D$, and $E \rightarrow A$.
   List the candidate keys for R.
   c) Define *super key* and *candidate key* with appropriate example. Write down the necessary 4
   conditions for *Boyce Codd normal form (BCNF)*

4. a) What is *normalization*? Consider the employees relational table given below and *normalize* 6
   the table up to 3rd Normal Form.

EMP_ID	NAME	JOB_CODE	JOB	STATE_CODE	HOME_STATE
E001	Alice	J01, J02	Chef, Waiter	26	Michigan
E002	Bob	J02, J03	Waiter, Bartender	56	Wyoming
E003	Reka	J01	Chef	56	Wyoming

b) Consider a relation R(A,B,C,D,E, F ,G, H) with the *functional dependencies-*   4
$$CH \rightarrow G \ \& \ A \rightarrow BC \ \& \ B \rightarrow CFH \ \& \ E \rightarrow A \ \& \ F \rightarrow EG$$
Now Find the A+, AD+, CD+, ABD+, FE+, and ABCD+ using following dependencies.

c) Define *lossy* and *lossless decomposition*.   2

5. a) Consider the following relational tables and write down the appropriate *SQL* commands for   6
joining the operations.
student(ID, name, dept name, tot_cred)
takes(ID, course-id, sec-id, semester, year, grade)
   I.   Left Join
   II.   Full join

b) What is a *procedure*? Write down the appropriate MYSQL commands to prepare procedure   6
for
   I.   Input an int number and return its square value.
   II.   Inserting a record into student table student (ID int, name varchar (30), GPA decimal (5,2), student_type varchar(15)).

6. a) There is a database table named **student** under the database "**ICT**" using the following   6
attribute student(ID int, name varchar(30), GPA decimal(5,2), student_type vatrchar(15)).

Now you have to write the necessary commands to create the database, tables, and design a
Before Insert trigger that automatically defines the value of student_type field based on the
value in the field GPA. For example

$$\begin{cases} if \ GPA > 3.75 \ then \ \text{student\_type} = Talented \\ elseif \ (GPA \leq 3.75 \ and \ GPA > 3.50) \ then \ \text{student\_type} = Good \\ else \ \text{student\_type} = Avrage \end{cases}$$

b) There are two tables having the following attribute as EMPLOYEES (employee_id INT   6
PRIMARY KEY, first_name VARCHAR(50), last_name VARCHAR(50), department
VARCHAR(50)) and deleted_employees_log (log_id INT AUTO_INCREMENT
PRIMARY KEY,employee_id INT, deleted_at TIMESTAMP DEFAULT
CURRENT_TIMESTAMP).

Now you have to write the necessary commands to create the tables, and design a **Before
delete Trigger** that automatically insert record into deleted_employees_log table before
deleting each record in EMPLOYEES table.

7. a) What is *indexing*? Draw the basic node structure of a *B+ tree*. Construct the *B+ tree* with   6
the instructor's name given below where the *pointer* value is 5(five).

Srinivasan, Wu, Mozart, Einstein, El Said, Gold, Katz, Califieri, Singh, Crick, Brandt, Kim

b) Write down the searching procedure in a *B+ tree*. Delete '**Srinivasan**' from the B+ tree given   6
below and redraw the B+ tree.
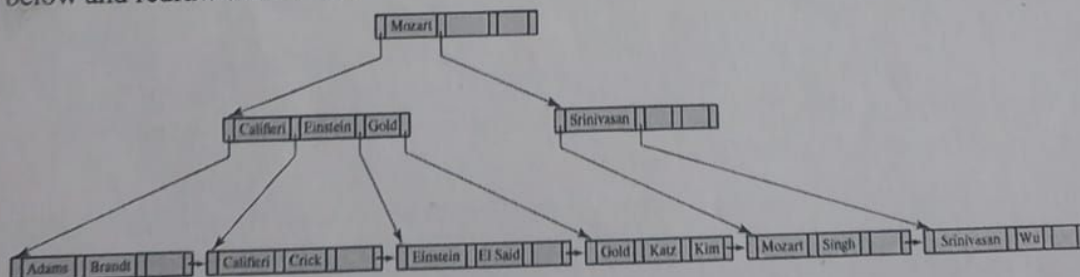
8. a) Define RAID. Describe the different RAID levels with examples   5

b) A *RAID* system with 25 disks, each with *Mean time to failure (MTTF)* of 10000 hours. Now   3
determine the *RAID* system's MTTF in hours.

c) What is a *Transaction*? Briefly explain the different states of a *Transaction* with proper   4
illustration.