Indian Institute of Engineering Science and Technology, Shibpur

B. Tech. 5th Semester End-Term Examination, November 2022

Subject: Database Management Systems (CS 3102)

Full marks: 50 **Time: 3 hours**

[Answer Question No. 1 and any four from the rest.]

1. Answer any five from the following questions:
   a) Define BCNF.
   b) Explain the generalized projection operation in relational algebra with an example.
   c) What are the advantages of views in relational database?
   d) Explain the ACID properties of a transaction?
   e) How can we prevent cascading rollback of transactions?
   f) What are the actions to be performed to take a check point in the system log?

[2×5]

2. a) Draw an ER diagram that represents a many to many relationship between two entity sets. Then convert it to its equivalent relational schema.
   b) Explain the idea of recursive relationship with the help of an ER diagram. Also show its conversion to relational schema.
   c) Compare and contrast centralized and distributed databases.

[3+3+4]

3. a) What are the different kinds of anomalies that may occur in DBMS?
   b) Given a relation R(P, Q, R, S, T, U, V, W, X, Y) and Functional Dependency set FD = { PQ → R, P → ST, Q → U, U → VW, and S → XY}, determine whether the given R is in 3NF? If not convert it into 3 NF.
   c) What advantage we achieve when a relation is in 4 NF?

[3+5+2]

4 Consider the following relational schema:

EMPLOYEE(NAME, SSN, SUPERSSN, SEX, ADDRESS, DNO, SALARY)
DEPARTMENT(DNAME, DNUMBER, DLOC)

Here SSN is the social security number of the employees. SUPERSSN is the SSN of the supervisors of the employees. DNO and DNUMBER imply department number. DLOC is the location of the departments.

a) Write the following queries in relational algebra.
   i) Retrieve the social security number of all the employees who either works in department number 5 or directly supervise an employee who works in department number 5.
   ii) Retrieve the maximum salary of each department excluding those that are below 10000.

b) Write the following queries in SQL.
   i) Retrieve the employee numbers and names of all employees along with their immediate supervisor's employee numbers and names. The result must include the employee number and name of the employees who do not have any supervisor.
   ii) List the employees who earn the lowest salary in their respective department.

[(2.5×2)+(2.5×2)]

5. a) Draw and explain the state transition diagram of a transaction.
   b) Explain the following problems (with suitable examples) that can occur when concurrent transactions execute in an uncontrolled manner.
      i) Lost update problem.
      ii) Dirty read problem.
   c) What is strict two-phase locking in transaction processing?

[3+(2.5×2)+2]

6. a) What do you mean by serializable schedule?
   b) Consider three transactions T_1, T_2 and T_3 that are performing read and write operations on three database items X, Y and Z in an interleaved manner as shown in the following schedule S.

   S: $r_2(Z)$; $r_2(Y)$; $w_2(Y)$; $r_3(Y)$; $r_3(Z)$; $r_1(X)$; $w_1(X)$; $w_3(Y)$; $w_3(Z)$; $r_2(X)$; $r_1(Y)$; $w_1(Y)$; $w_2(X)$.

   Here, $r_i(.)$ and $w_i(.)$ represents read and write operations performed by transaction T_i, respectively. Explain the rules of constructing precedence graph for a given schedule and draw the precedence graph for the schedule S to determine whether it is serializable or not.
   c) Explain the deferred update technique of database recovery.

[2+5+3]