2022

ADVANCED DBMS

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. a) Let a Relation R have attributes {a1, a2, a3,…, an} and the candidate keys   3
        are "a1", "a2". Find out the possible number of super keys?

    b) Consider a relation R (A, B, C, D, E) with the following three functional   7
        dependencies: $AB \rightarrow C$; $BC \rightarrow D$; $C \rightarrow E$;
        Determine the total number of candidate keys and superkeys in the relation
        R.

    c) Consider the following relation schema: 2 x 5 = 10
        EMPLOYEE (fname, lname, ssn, bdate, address, gender, salary, superssn,
        dno)
        DEPARTMENT (dname, dno, mgrssn)
        PROJECT (pname, pnumber, plocation, dno)
        WORKS_ON (ssn, pno, hours)
        DEPENDANT (ssn, ddent_name, gender, bdate, relationship)

        Write SQL queries for the following:

        I.   Retrieve the name of each employee who works on all the projects
              controlled by department number 5.

        II.   Retrieve the names of employees who have no dependents.

        III. For each project, retrieve the project number, the project name and
              the number of employees who work on that project.

        IV.   For each project on which more than two employees work, retrieve
              the project number, the project name and the number of employees
              who work on the project.

        V.   For each department that has more than five employees, retrieve the
              department number and the number of its employees who are
              making salary more than 40,000.

2. a) Consider the transactions T1, T2, and T3 and the schedules S1 and S2 given below. **12**

T1: r1(X); r1(Z); w1(X); w1(Z)
T2: r2(Y); r2(Z); w2(Z)
T3: r3(Y); r3(X); w3(Y)
S1: r1(X); r3(Y); r3(X); r2(Y); r2(Z); w3(Y); w2(Z); r1(Z); w1(X); w1(Z)
S2: r1(X); r3(Y); r2(Y); r3(X); r1(Z); r2(Z); w3(Y); w1(X); w2(Z); w1(Z)
Construct precedence graphs for the schedules S1 and S2 and determine whether they are conflict serializable or not.

   b) Discuss the atomicity, durability, isolation and consistency preservation properties of a database transaction. **8**

3. a) What are the variations of two phase locking protocol? Briefly explain them. **6**

   b) Discuss the problems of deadlock and starvation and the different approaches to dealing with these problems. **14**

4. a) Write the external merge sort algorithm and explain it with a suitable example. **14**

   b) Define the following terms: **1½ x 4 = 6**
       query evaluation plane, query execution engine, evaluation primitive, query optimization

5. a) Let suppose, a relation R (P, Q, R, S) with a set of Functional Dependency FD = (PQ→R, R→S, S→P) is given. Relation R is decomposed into R1 (P, Q, R) and R2(R, S). Find out whether the decomposition is dependency preserving or not. **10**

   b) Given a set of functional dependencies FD = (A -> BC, B -> C, A -> B, AB -> C), find the canonical cover. **10**

6. a) Consider the following relation R: **12**

A	B	C	D	E
p	250	6	a	x
q	350	5	b	y
p	200	6	c	z
r	460	4	d	w

Which of the following decomposition is lossless, justify your answer:

   I.   R1(A B), R2(C D)

II.   R1(A B C), R2(D E)

III.   R1(A B C), R2(C D E)

IV.   R1(A B C D), R2(A C D E)

V.   R1(A B C D), R2(D E)

VI.   R1(A B C), R2(B C D), R3(D E)

b) Explain the difference between 3NF and BCNF with a suitable example.   8