

Roll No.....

Dr B R Ambedkar National Institute of Technology, Jalandhar

B Tech 4th Semester (Computer Science and Engineering)

CSPC-202, Database Management System

End-Semester Examination, May-2024

Duration: 03 Hours Max. Marks: 50 Date: 16th May 2024

Marks Distribution & Mapping of Questions with Course Outcomes (COs)																		
Question Number	1a	1b	2a	2b	3a	3b	4a	4b	5a	5b	6a	6b	7a	7b	8a	8b	9	10
Max. Marks	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	5	5
CO No.	1	1	2	4	3	1,2	3,4	2	3	3	1	2,3	4	3	2	2,4	2	1,4
Cognitive Level	U, R	R	Ap, C	Ap, C	E	An	Ap	E	R	Ap	R	E	R	An	R	An, E	Ap	R
Section/Chapter/Unit	3	1	2	4	5	4	5	6	4	6	6	7	8	6	8	7	4	1-10

Note:

- Attempt all the questions.
- Consider the following transaction involving two bank accounts x and y.
read (x); x := x – 50 ; write (x)
read (y) ; y:= y + 50 ; write (y)
What constraint (ACID) ensures that the total amount across accounts x and y remains unchanged during the given transaction? (2)
b) How do Data Definition Language (DDL) and Data Manipulation Language (DML) differ in their roles within a retail company's implementation of a database management system (DBMS) for online sales expansion? Provide at least two most suitable examples of each of the DDL and DML commands to illustrate their respective functions. (3)
 - A comprehensive database system is being developed for a hospital to manage patient care, staff information, and administrative processes efficiently. The system should handle patient admissions, medical records, staff scheduling, inventory management, and billing seamlessly.
 - Design an E-R schema diagram illustrating the relationships and entities involved in this application, emphasizing the dynamic interactions between patients, doctors, nurses, medical procedures, medications, and administrative entities. (2)
 - Map the E-R diagram into a relational model, delineating the tables, attributes, and relationships required to support the functionalities of the hospital database. Ensure the relational model captures data integrity through appropriate constraints and reflects the complex nature of healthcare operations effectively. (3)

- Consider the following two sets of functional dependencies:
 $F = \{A \rightarrow C, AC \rightarrow D, E \rightarrow AD, E \rightarrow H\}$ and
 $G = \{A \rightarrow CD, E \rightarrow AH\}$.
Check whether they are equivalent. (2)
 - Consider the universal relation $R = \{A, B, C, D, E, F, G, H, I, J\}$ and the set of functional dependencies $F = \{\{A, B\} \rightarrow \{C\}, \{A\} \rightarrow \{D, E\}, \{B\} \rightarrow \{F\}, \{F\} \rightarrow \{G, H\}, \{D\} \rightarrow \{I, J\}\}$. What is the key for R? Decompose R into 2NF and then 3NF relations. (3)

- Consider the relation REFRIG(MODEL#, YEAR, PRICE, MANUF_PLANT, COLOR), which is abbreviated as REFRIG (M, Y, P, MP, C), and the following set F of functional dependencies: $F = \{M \rightarrow MP, \{M, Y\} \rightarrow P, MP \rightarrow C\}$
a) Evaluate each of the following as a candidate key for REFRIG, giving reasons why it can or cannot be a key: $\{M\}, \{M, Y\}, \{M, C\}$. (2)
b) Based on the above key determination, state whether the relation REFRIG is in 3NF and BCNF, giving proper reasons. (3)
- What is Join? Differentiate between natural join and full join with example. (2)
 - Consider the following relations for a database that keeps track of student enrolment in courses and the books adopted for each course:
STUDENT(SSN, Name, Major, Bdate)
COURSE(Course#, Cname, Dept)
ENROLL(SSN, Course#, Quarter, Grade)
BOOK_ADOPTION(Course#, Quarter, Book ISBN)
TEXT(Book ISBN, Book Title, Publisher, Author)
Specify the foreign keys for this schema, stating any assumptions you make. Next, populate the relations with a few examples of tuples, and then give an example of an insertion in the ENROLL and BOOK_ADOPTION relations that violates the referential integrity constraints and of another insertion that does not. (3)
- What is the system log used for? What are the typical kinds of records in a system log? (2)
 - Consider the three transactions T1, T2, and T3, and the schedules S1 and S2 given below.
T1: r1 (X); r1 (Z); w1 (X);
T2: r2 (Z); r2 (Y); w2 (Z); w2 (Y);
T3: r3 (X); r3 (Y); w3 (Y);
S1: r1 (X); r2 (Z); r1 (Z); r3 (X); r3 (Y); w1 (X); w3 (Y); r2 (Y); w2 (Z); w2 (Y);
S2: r1 (X); r2 (Z); r3 (X); r1 (Z); r2 (Y); r3 (Y); w1 (X); w2 (Z); w3 (Y); w2 (Y);

Draw the serializability (precedence) graphs for S1 and S2 and state whether each schedule is serializable or not. If a schedule is serializable, write down the equivalent serial schedule(s). (2+1)

7. a) What is meant by cascading rollback? Why do practical recovery methods use protocols that do not permit cascading rollback? (2)

b) Consider the following ordering Schedule – ‘S’ of transactions:

T1: R(A); T1 : A:=A+5; T1 ; commit;

T2: R(B); T2 : B:= B+5; T3 : R(C);

T3: C:= C+5; T3 : C:= C+5; T4 : R(A);

T4: A:= A+5; T4 : R(D); T4 : D:=D+5;

T4: commit; T2: commit; T3: commit;

Let the initial value of A=B=C=D=0. The system follows a log-based recovery process of immediate database modification. The assumption is the concurrency control system uses strict 2PL, and all the transactions share a common disk buffer and single log. Explain what happens during the recovery process, if failure occurs at the ‘T2: commit’ statement. (3)

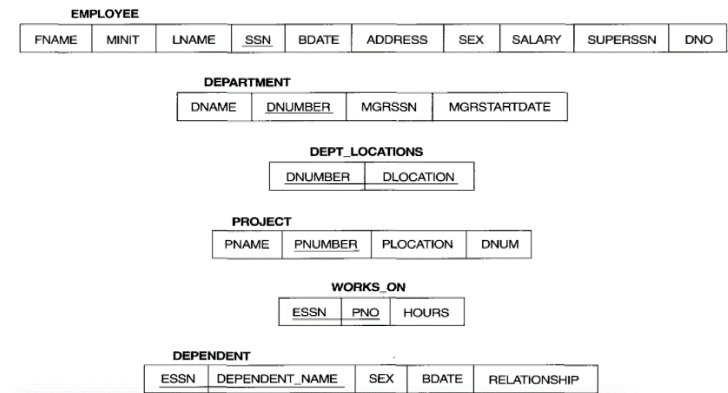
8. a) What are some variations of the two-phase locking protocol? Why is strict two-phase locking often preferred? (2)

b) The following figure shows the log corresponding to a particular schedule at the point of a system crash for four transactions T1, T2, T3, and T4.

```
[start_transaction, T1]
[read_item, T1, A]
[read_item, T1, D]
[write_item, T1, D, 20, 25]
[commit, T1]
[checkpoint]
[start_transaction, T2]
[read_item, T2, B]
[write_item, T2, B, 12, 18]
[start_transaction, T4]
[read_item, T4, D]
[write_item, T4, D, 25, 15]
[start_transaction, T3]
[write_item, T3, C, 30, 40]
[read_item, T4, A]
[write_item, T4, A, 30, 20]
[commit, T4]
[read_item, T2, D]
[write_item, T2, D, 15, 25] ← system crash
```

Suppose that we use the immediate update protocol with check pointing. Describe the recovery process from the system crash. Specify which transactions are rolled back, which operations in the log are redone which (if any) are undone, and whether any cascading rollback takes place. (3)

9. Write SQL queries on the database schema shown in Figure.



- Retrieve the names of all employees in department 5 who work more than 10 hours per week on the 'ProductX' project.
- Find the names of all employees who are directly supervised by Piyush.
- For each department, retrieve the department name and the average salary of all employees working in that department.
- Retrieve the average salary of all female employees.
- Find the names and addresses of all employees who work on at least one project located in Jalandhar but whose department has no location in Jalandhar. (1×5=5)

10. Attempt following fill in the blanks and true/false questions:

- _____ command is used to delete attributes from the table.
- _____ symbol is used for projection in relation algebra.
- _____ are used to identify the relationships between attributes in a database schema.
- _____ is a technique used to ensure that transactions are executed as if they were executed serially.
- _____ is a classification of failures where the database system crashes without warning.
- Truncate command comes under DDL (T/F)
- A table can have only one foreign key (T/F)
- “Each entity must have the primary key”, this condition also applies to weak entities. (T/F)
- The undo and redo operations must be commutative to guarantee correct behavior, even if a failure occurs during the recovery process. (T/F)
- Recovery based on deferred updates always requires a redo log. (T/F)

(0.5×10=5)