B.Tech Even Semester Examination, May, 2025

Computer Science & Engineering
(4th Semester)

Course No: CSE-253/CSE-403
(Database Management Systems)

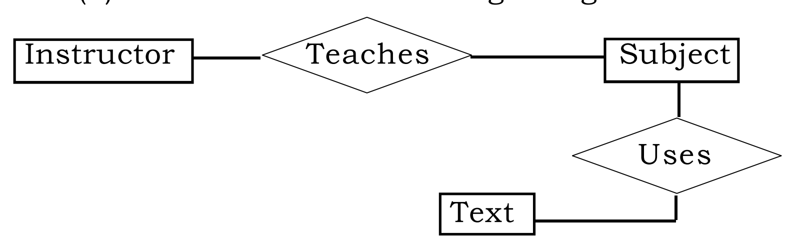
Full Marks: 70
Pass Marks: 28
Time: 3 hours

Note:
1. Attempt any five questions taking one each unit.
2. Begin each answer in a new page
3. Answer parts of a question at a place
4. Assume reasonable data wherever required
5. The figure in the right margin indicates full marks for the question
6. All the mathematical symbols and abbreviations have their usual meanings.

UNIT-I

1. (a) When would you store data in a DBMS instead of in operating system files and vice-versa? 4

(b) Consider the E-R diagram given below:



Assume that a subject may or may not use a text book, but that a text by definition is a book that is used in some subjects. A subject may not use more than five books. Instructors teach from two to four subjects.

(i) Supply the attributes for the entity types and mark the key attributes.

(ii) Specify the cardinality ratio and participation constraints in the diagram.

(iii) If we add the relationship ADOPTS between Instructor and Text, what structural constraints would you put on it? 2+2+2=6

(c) What do you mean by data abstraction in DBMS? List out the different levels of data abstractions that are used in DBMS's three-tier architecture. 2+2=4

2. (a) What are the different completeness constraints used in the Extended E-R model? Explain each of them with an appropriate example. 1+4=5

(b) Define the term entity integrity constraint and referential integrity constraint. Can we express these constraints in relational algebra? How are these constraints expressed in SQL? 2+1+2=5

(c) Define the concept of aggregation in the E-R model. Give one example of where this concept is useful. 2+2=4

UNIT-II

3. (a) Consider the following schema:

Suppliers (sid, sname, address)

Parts (pid, pname, color)

Catalog (sid, pid, cost)

Write the Tuple Relational Calculus (TRC) of the following queries.

single file of records? 1+1+1+2=5

10. (a) What is a clustered index? What is a primary index? Explain how many clustered indexes you can build on a file. 1+1+3=5

(b) How are dense and sparse indices used in the sequentially ordered files? What is the limitation of the dense and sparse index? 2+2=4

(c) Describe two possible page formats. What are the trade-offs between them? 2+3=5

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8. (a) What are the different phases involved in Crash recovery? Explain each of them. 1+3=4

(b) Prove that the two-phase locking protocol (2PL) may not be free from starvation when several transactions execute simultaneously in a database. 4

(c) Consider a database with objects X and Y and assume that there are two transactions T1 and T2. Transaction T1 reads objects X and Y and then writes object X. Transaction T2 reads objects X and Y and then writes objects X and Y.

(i) Given an example schedule with actions of transaction T1 and T2 on objects X and Y that results in a write-read conflict.

(ii) Given an example schedule with actions of transaction T1 and T2 on objects X and Y that results in a read-write conflict.

(iii) Given an example schedule with actions of transaction T1 and T2 on objects X and Y that results in a write-write conflict. 2+2+2=6

UNIT-V

9. (a) Describe two possible record formats. What are the trade-offs between them? 2+3=5

(b) What is record id, or rid? Given a record's id, how many I/O are needed to fetch it into memory? 2+2=4

(c) What is file organization? What is an index? What is the relationship between files and indexes? Can we have several indexes on a

(i) Find the sids of suppliers who supply every part.

(ii) Find the sids of suppliers who supply every red part. 2+2=4

(b) Let R=(A, B, C) and r1 and r2 both relations on schema R. Give an expressions in SQL that is equivalent to each of the following queries:

(i) $r_1 \cup r_2$ (ii) $r_1 \cap r_2$ (iii) $r_1 - r_2$

(iv) $\prod AB\ (r_1) \bowtie \prod_{BC}(r_2)$ 2+2+2+2=8

(c) What is the difference between the following two SQL commands:

DROP TABLE tablename RESTRICT and DROP TABLE tablename CASCADE 1+1=2

4. (a) Consider the following relational schema:

Employee (empno, name, office, age)

Book (isbn, title, author, publisher)

Loan (empno, isbn, date)

Write the following queries in relational algebra (RA).

(i) Find the name of employees who have borrowed a book published by McGraw-Hill.

(ii) Find the names of employees who have a borrowed all books published by McGraw-Hill. 2+2=4

(b) Consider the employee database of the following, where the primary keys are underlined. Give an expression in Domain Relational Calculus (DRC) for each of the following queries.

Employee (employee-name, street, city)

Works (employee-name, company-name, salary)

Company (company-name, city)

Manages (employee-name, manager-name)

(i) Find the names of all employes who work for "First Bank Corporation".

(ii) Find the names and cities of residence of all employee who works for "First Bank Corporation".

(iii) Find the name, street, and cities of residence of all employees who works for "First Bank Corporation" and earn more than $10,000 per annum. 2+2+2=6

(c) How SQL droped the view and modifies the structure of an existing table? 2+2=4

UNIT-III

5. (a) For each of the following relation schemas and set of FDs:

(1) R is (A, B, C, D) with FDs: {**A→B, B→C, C→D, D→A**}

(2) R is (A, B, C, D) with FDs: {**B→C, B→D**}

(i) Identify candidate keys of R.

(ii) Indicate BCNF violations and decompose if necessary.

(iii) Indicate 3NF violations and decompose if necessary. 2+2+2=6

(b) Consider a relation R with five attributes A,

B, C, D, E. You are given the following functional dependencies: **A→B, BC→E,** and **ED→A.**

(i) List all keys of R.

(ii) Is R in 3NF?

(iii) Is R in BCNF? 2+2+2=6

(c) What is the condition that ensures the functional dependency is a completely non-trivial dependency? 2

6. (a) Give a set of FDs for the relational scheme R(A, B, C, D) with primary key AB under which R is in 1NF but not in 2NF. 5

(b) Let us consider R (A, B, C, D) with Fds {**A→B, B→C, C→D, D→B**}. The relation R is decomposed into R1 (A, B), R2 (B, C), and R3 (B, D). Now, after decomposition, check whether the decomposed relations exist in the dependency preservation or not. 6

(c) Write a complete procedure to compute the closure of the attribute set. 3

UNIT-IV

7. (a) Prove that every conflict serializable schedule is view serializable. 5

(b) Show that the two-phase locking protocol (2PL) ensures serializability when several transactions execute simultaneously in a database. 5

(c) Define the term schedule, dirty read, strict schedule and recoverable schedule. 1+1+1+1=4