

Question Paper

Exam Date & Time: 24-Jun-2024 (02:30 PM - 05:30 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

FOURTH SEMESTER B.TECH. DEGREE EXAMINATIONS - JUNE 2024

SUBJECT: CSE 2224/CSE_2224 - DATABASE SYSTEMS

(SPL: COMPUTER SCIENCE AND ENGINEERING - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING / COMPUTER SCIENCE / COMPUTER SCIENCE AND ENGINEERING - CYBER SECURITY)

Marks: 50

Duration: 180 mins.

Answer all the questions.

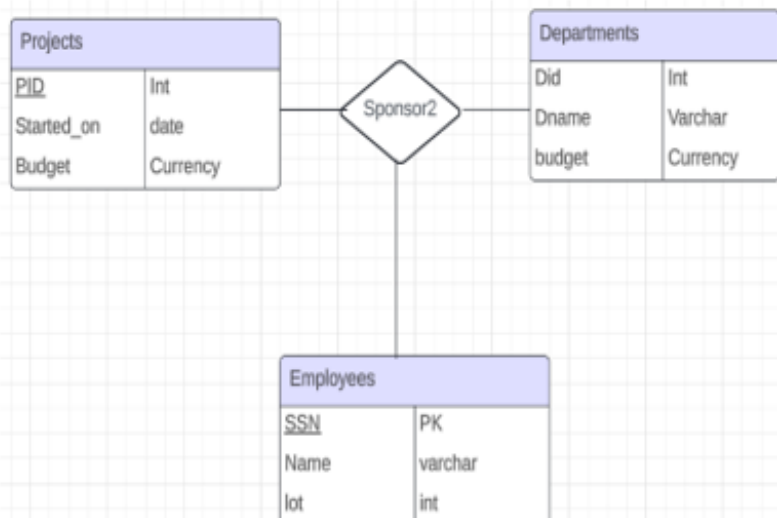
- 1A) Consider A factory schema with two relations: Worker(WID, Name, Salary, Role) (5)
Factory(Dept_ID, DName, WID, budget)
Write queries in relational algebra for the following questions:
i) Obtain the total number of employees working in each dept
ii) List employee ID, for those with salary greater than max budget amongst all departments
iii) Obtain max budget without using aggregate functions
- 1B) Specify the different components of storage manager in database system. Mention the data (3)
structures used as part of the physical system implementation of storage manager and also indicate why are they needed?
- 1C) Assume basic timestamp ordering protocol and that time starts from 1, each operation takes unit (2)
amount of time and start of Transaction T_i is denoted as S_i . The table of timestamp is given below:

Time	OP
1	S_1
2	$r1(a)$
3	S_2
4	$r2(b)$
5	$w2(b)$
6	$w1(a)$
7	S_3
8	$w3(a)$
9	$w3(b)$

Calculate $rts(a)$, $wts(a)$, $rts(b)$ and $wts(b)$ at the end of time 9.

- 2A) Which of the following schedules is (conflict) serializable? For each serializable schedule, determine (4)
the equivalent serial schedules.
i) $r1(X); r3(X); w1(X); r2(X); w3(X)$
ii) $r1(X); r3(X); w3(X); w1(X); r2(X)$
iii) $r3(X); r2(X); w3(X); r1(X); w1(X)$
iv) $r3(X); r2(X); r1(X); w3(X); w1(X)$
- 2B) Consider the below E-R diagram for the following problem statement: "Each Project entity is (3)
sponsored by one or more Department entities and each Department can sponsor zero, one or
more Projects. Each Sponsorship relationship has a Monitors relationship, which connects

Employees with Sponsorship." Modify the E-R diagram to use aggregation. Also add an additional constraint that each Sponsorship relationship is monitored by at most one Employee.



2C) Justify with appropriate examples in which cases is it bad to employ "ON UPDATE CASCADE" or "ON DELETE CASCADE" for foreign keys? Why does this mechanism exist at all? (3)

3A) Consider the following tables: (4)

Customers(cid,cname, rating, age)

Cars(carid, carname, color)

Reserves(cid,carid,day)

Write the SQL queries for the following:

i) Find all information of customers who have reserved carid 101.

ii) Find the names of customers who have reserved a red car and list in the order of age.

iii) Find the ids of customers who have reserved a red car or a green car.

iv) Find the names of customers who have reserved all cars.

3B) i) Give the BCNF rules of decomposition of a functional dependency which is not in BCNF. (4)

ii) Consider a relational schema $R = (A, B, C, D, E)$ with set of functional dependencies are given as $F = \{A \rightarrow B, BC \rightarrow D\}$ where R is decomposed into $R_1(AB)$ and $R_2(ACDE)$. Check whether the functional dependencies are preserved or not

3C) Describe the purpose and functionality of the SQL GROUP BY clause. How does GROUP BY differ from the WHERE clause? (2)

4A) Consider the following two transactions and schedule (time goes from top to bottom). (3)

Transaction T_0	Transaction T_1
$r_0[A]$	
$w_0[A]$	
	$r_1[A]$
	$r_1[B]$
	c_1
$r_0[B]$	
$w_0[B]$	
c_0	

i) Is this schedule conflict-serializable? Explain why or why not.

ii) Show how 2PL can ensure a conflict-serializable schedule for the same transactions given. Use the notation $L_i[A]$ to indicate that transaction i acquires the lock on element A and $U_i[A]$ to indicate that transaction i releases its lock on A .

4B) In a relational database design. Consider given relation schema $R = (A, B, C, D, E, F, G, H)$ and the following set of functional dependencies: $F = \{A \rightarrow B, ABCD \rightarrow E, EF \rightarrow G, EF \rightarrow H, ACDF \rightarrow EG\}$ (4)

i) Compute the canonical cover for F .

ii) Decompose R into 3rd Normal Form.

iii) Prove that your 3NF decomposition is a lossless join.

- 4C) Draw an ER diagram for the following requirements. (3)
 Consider a MAIL_ORDER database in which employees take orders for parts from customers. The data requirements are summarized as follows:
- The mail order company has employees, each identified by a unique employee number, first and last name, and ZIP code.
 - Each customer of the company is identified by a unique customer number, first and last name, and ZIP code.
 - Each part sold by the company is identified by a unique part number, a part name, price, and quantity in stock.
 - Each order placed by a customer is taken by an employee and is given a unique order number. Each order contains specified quantities of one or more parts. Each order has a date of receipt as well as an expected ship date. The actual ship date is also recorded.
- 5A) Consider the given fixed-length table. Consider the deletion of record 5 from the given Figure. (2)
 Compare the relative merits of the following techniques for implementing the deletion:
- Move record 6 to the space occupied by record 5 and move record 7 to the space occupied by record 6.
 - Mark record 5 as deleted and move no records.
- | | | | | |
|-----------|-------|------------|------------|-------|
| record 0 | 10101 | Srinivasan | Comp. Sci. | 65000 |
| record 1 | 12121 | Wu | Finance | 90000 |
| record 2 | 15151 | Mozart | Music | 40000 |
| record 11 | 98345 | Kim | Elec. Eng. | 80000 |
| record 4 | 32343 | El Said | History | 60000 |
| record 5 | 33456 | Gold | Physics | 87000 |
| record 6 | 45565 | Katz | Comp. Sci. | 75000 |
| record 7 | 58583 | Califieri | History | 62000 |
| record 8 | 76543 | Singh | Finance | 80000 |
| record 9 | 76766 | Crick | Biology | 72000 |
| record 10 | 83821 | Brandt | Comp. Sci. | 92000 |
- 5B) Analyse the utilization of logs in the context of redo and undo operations within transactions. (4)
 Develop a suitable example to illustrate the practical implementation of redo and undo operations.
- 5C) Consider the following actions taken by transaction T1 on databases X and Y: R(X), W(X), R(Y), W(Y) (4)
 i) Give an example of another transaction T2 that, if run concurrently to transaction T1 without some form of concurrency control, could interfere with T1.
 ii) Explain how the use of Strict 2PL would prevent interference between the two transactions.

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