

(3)

Monsoon Mid-Semester Examination, Session 2022-23

Examination & Semester: M.Tech. (Computer Science and Engineering) I Semester

Subject: Advanced DBMS (CSC502)

Time: 2 Hours

Max. Marks: 56

Instructions:

(a) All questions are compulsory.

(b) Attempt the questions in serial order.

Q. No.	Question	Marks
1. (a)	Consider the relational database <i>employee</i> (<u>person_name</u> , street, city) <i>works</i> (<u>person_name</u> , company_name, salary) <i>company</i> (<u>company_name</u> , city) <i>manages</i> (<u>person_name</u> , manager_name) Give an expression in the Relational Algebra (using Basic Operators only) for each request: (i) Modify the database so that Amit now lives in Dhanbad city. (ii) Give all employees of Facebook a 10 percent salary raise. (iii) Find the names of all employees in this database who live in the same city as the company for which they work.	6
(b)	Consider a relation $r(A, B, C, D, E, F, G)$ satisfies the following functional dependencies: $F = \{A \rightarrow B, BC \rightarrow DE, AEF \rightarrow G\}$. Find the closure of $\{AC\}$ under this set. Is functional dependency $ACF \rightarrow DG$ implied by F ? Show the complete steps.	4
2. (a)	Suppose you are given a relation R with four attributes $ABCD$. For each of the following sets of FDs, assuming those are the only dependencies that hold for R , do the following: (a) Identify the candidate key(s) for R . (b) Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). (c) If R is not in BCNF, decompose it into a set of BCNF relations that preserve the dependencies. Show each decomposition step (if any) clearly. (i) $C \rightarrow D, C \rightarrow A, B \rightarrow C$ (ii) $B \rightarrow C, D \rightarrow A$ (iii) $ABC \rightarrow D, D \rightarrow A$	6
(b)	A relation $r(A, B, C, D, E, F)$ has the following set of functional dependencies: $F = \{A \rightarrow CD, B \rightarrow C, F \rightarrow DE, F \rightarrow A\}$. The relation is decomposed into $r_1(A, B, C)$, $r_2(A, F, D)$, and $r_3(E, F)$. Check whether this decomposition is lossless or lossy?	4
3. (a)	Construct a B+-tree for the following set of key values: (2, 3, 5, 7, 11, 17, 19, 23, 29, 31) Assume that the tree is initially empty and values are added in ascending order. (I) Construct B+-trees for the cases where the number of pointers that will fit in one node is 6. (II) Show the steps involved in the following queries: (i) Find records with a search-key value of 11. (ii) Find records with a search-key value between 7 and 17, inclusive (III) Show the form of the tree after each of the following series of operations: (i) Insert 9 (ii) Insert 10 (iii) Insert 8 (iv) Delete 23 (v) Delete 19	8
(b)	Assume that only one tuple fits in a block and memory holds at most 3 page frames. Show the runs created on each pass of the sort-merge algorithm, when applied to sort the following tuples on the first attribute: (kangaroo, 17), (wallaby, 21), (emu, 1), (wombat, 13), (platypus, 3), (lion, 8), (warthog, 4), (zebra, 11), (meerkat, 6), (hyena, 9), (hornbill, 2), (baboon, 12).	4
4. (a)	Let relations $r_1(A, B, C)$ and $r_2(C, D, E)$ have the following properties: r_1 has 20,000 tuples, r_2 has 45,000 tuples, 25 tuples of r_1 fit on one block, and 30 tuples of r_2 fit on one block. Estimate the number of block accesses required, using each of the following join strategies for $r_1 \bowtie r_2$: (i) Nested-loop join. (ii) Block nested-loop join (iii) Merge join (iv) Hash join	8
(b)	What factors could result in skew when a relation is partitioned on one of its attributes by: (i) Hash partitioning (ii) Range partitioning In each case, what can be done to reduce the skew?	4

5. (a)	Consider join processing using symmetric fragment and replicate with range partitioning. How can you optimize the evaluation if the join condition is of the form $ r.A - s.B \leq k$, where k is a small constant. Here, $ x $ denotes the absolute value of x . A join with such a join condition is called a band join.	6
(b)	Describe a good way to parallelize each of the following. (i) The difference operation (ii) Aggregation by the count operation (iii) Aggregation by the count distinct operation (iv) Aggregation by the avg operation (v) Left outer join, if the join condition involves only equality. (vi) Left outer join, if the join condition involves comparisons other than equality.	6