Birla Institute of Technology & Science, Pilani
Work-Integrated Learning Programmes Division
First Semester 2018-2019

Comprehensive Examination
(EC-3 Regular)

Course No.   : CSI ZG518
Course Title   : DATABASE DESIGN & APPLICATIONS
Nature of Exam   : Open Book
Weightage   : 50%
Duration   : 3 Hours
Date of Exam   : 25/11/2018   (AN)

No. of Pages   = 2
No. of Questions = 6

Note:
1. Please follow all the *Instructions to Candidates* given on the cover page of the answer book.
2. All parts of a question should be answered consecutively. Each answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

Q.1. What are different reasons for variable-length records in database systems? How databases stores them?   [5]

Q.2. Explain the difference between
      (a)   second level index and secondary index with an example.
      (b)   2NF and 4NF
      (c)   Functional Dependency and Multi-Valued Dependency   [3 x 3 = 9]

Q.3. Consider the following relation describing employees in a company:
      Employee (eno : integer, name: string, phone: integer, age: integer, salary: real)
      The relation is stored as a sorted file in increasing lexicographic order of (name, eno).

      For each of the following, answer True or False, and **explain your answer** *briefly* in the space provided.
                i.   It is possible to build a sparse index on name
               ii.   It is possible to build a dense index on age
              iii.   It is possible to build a sparse index on phone
               iv.   It is possible to build a sparse index on eno   [1.5 x 4 = 6]

Q.4. Suppose we have a database for an investment firm, consisting of the following attributes:

      B – Broker,
      O – Office of a broker
      I – Investor
      S – Stock
      Q – Quantity of stock owned by an investor
      D – dividend paid by a stock.
      Hence, the overall schema is R = (B, O, I, S, Q, D).
      Assume that the following functional dependency. are required to hold on this database

      I → B, IS → Q, B → O, S → D.
      (a)   List all the candidate keys for R.
      (b)   Give a lossless-join decomposition of R into BCNF.
      (c)   Give a lossless-join decomposition of R into 3NF preserving functional dependency. Is you answer is in BCNF?   [3 + 4 + 3 = 10]

Q.5. Draw an extensible hash table that contains the elements 2, 4, 8, 9, 11, 12, 13, 14, 16, 17, 18, 20, 23. Assume that each hash bucket has space for four entries. The hash function is f(x) = x.

  (a) What is the smallest number of entries whose insertion will cause the creation of a new bucket in the hash table? Given an example to explain.

  (b) What is the smallest number of entries whose insertion will increase the global depth of the hash table? Given an example to explain.   [4 + 2 + 2 = 8]

Q.6. Consider the following schedules (S1 and S2). The actions are listed in the order they are scheduled, and prefixed with the transaction name.

S1: T1:R(A), T1:W(A), T3:R(A), T3:W(A), T2:R(B), T2:W(B), T3:R(C), T3:W(C), T1:R(C), T1:W(C), T1:R(B), T1:W(B)

S2: T1:R(X), T2:R(X), T1:R(Y), T2:R(Y), T3:R(X), T4:R(Y), T1:W(X), T2: W(Y)

(a)   (5 points) Draw the precedence graph for S1 and S2
(b)   (5 points) Is S1 or S2 a conflict serializable schedule? If yes, what is the equivalent serial schedule? If no, explain in 1-2 lines.
(c)   (5 points) From the following options, choose which of the anomalies is present in S1 and S2 (if any). Explain in 1-2 lines which actions cause that anomaly.
    a. Dirty read
    b. Unrepeatable read
    c. Lost update   [4 + 4 + 4 = 12]

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