Department of Computer Science and Engineering
Indian Institute of Technology Patna

Databases:CS354
Autumn 2017-18

Duration: 2 hours Full Marks: 60

**Answer all questions.** You may answer the questions in any order. However all parts of the same questions must be answered together. Clearly state any reasonable assumptions you make.

1. Consider the the following requirements relating to a child's nursery/playgroup.

   - A Parent can have many Children
   - A Child can have at most two Parent details recorded
   - The Nursery holds many different Sessions (a session could be a Monday morning 8:00am - 12:00pm)
   - A Child could be Registered against many Sessions (the child may go to nursery only three ~~mornings~~ sessions a week)
   - The following queries will be frequently used -
     - **Query 1:** Locating the preferred contact details of a particular child's parents
     - **Query 2:** The number of children registered for each session of a week
     - **Query 3:** How much does each Parent owe in nursery fees for their children

   Construct an ER Diagram (using the basic notation) for the above specification. Clearly show the cardinality and participation constraints along with some relevant attributes for each entities. For each relationship you may add some new attributes.

   Now if each of the above entities and relationships are mapped to a relation (table) then how many relations (along with which one) will be required to access for each of the above Query 1, 2 and 3?

   15 Marks

2. Consider the following two sets of functional dependencies:

   - $F = \{A \rightarrow C, AC \rightarrow D, E \rightarrow AD, E \rightarrow H\}$ and
   - $G = \{A \rightarrow CD, E \rightarrow AH\}$

   5 Marks

   Check whether or not they are equivalent.

3. Given a relation schema R(A,B,C,D,E,F,G) and functional dependencies

   - $E \rightarrow ACB$
   - $A \rightarrow CD$
   - $CD \rightarrow F$
   - $D \rightarrow G$

   Show a possible instance of this relation with 10 records. Is this relation in BCNF? Show your decomposition and establish its correctness based on the concepts of BCNF, lossless join, and dependency preserving. You may not be able to find a decomposition that satisfies all requirements. Justify your preferences. 10 Marks

4. Consider the following three relations:

   - Enroll( student, course ) /* students enrolled in a course */
   - Teaches( teacher, course ) /* teacher of courses */
   - Likes( student, teacher ) /* student likes a teacher */

   Now answer the followings-

   (a) Write in Tuple Relational Calculus and Domain Relational Calculus the query "Find the list of courses in which atleast two students have registered"

   (b) Express in relational algebra operation (but without using any aggregate operation) the followings-

      i. Find the students who are enrolled to courses which are taught by none of the teachers they like

      ii. Find the students who are enrolled to courses which are taught by atleast a teacher they like

      iii. Find the students who are enrolled to courses which are all taught by the teachers they like

   $(2 \times 4) + (3 \times 4)$=20 Marks

5. State whether the followings are **TRUE** or **FALSE** and then give supporting justification with an example.

   (a) A relation can always be decomposed into two non-loss components.

   (b) No relation can be both in BCNF and 3NF.

   $2 \times 5$=10 Marks