INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

Mid-Spring Semester 2017-18

Date of Examination: 22/2/2018 Session(FN/AN): AN Duration 2hrs Full Marks: 30
Subject No.:MA40004/MA60050/MA61018 Subject: File Organization and Database Systems
Department/Center/School: Mathematics
Answer **ALL** Questions
This Question Paper consists of **TWO Pages**

1. Suppose you are given the following requirements for a simple database for the Indian Football League (IFL) :
   - The IFL has many teams
   - Each team has a name, city, a coach, a captain and a set of players
   - Each player belongs to only one team
   - Each player has a name, a position (such as right back or goalie), a skill level and a set of injury records
   - A team captain is also a player
   - A game is played between two teams (referred to as host-team and guest-team) and has a date (such as 19.02.2018) and a score (such as 4 to 2)

   a. Construct a clean and concise ER diagram for the IFL database.
   b. Construct the **relational model** and **hierarchial model** corresponding to the above ER diagram with proper justification. **(3M+3M)**

2. a. Consider a relational scheme R(A, B, C, D, E, F, H) with FDs {A→D, AE→H, DF→BC, E→C, H→E}. Suppose R is decomposed to four subrelations R1(A, E, H); R2(A, B, E, C); R3(A, D) and R4(C, E). Is this decomposition in BCNF or 3NF or 1NF? Justify your answer.

   b. Define multivalued dependency. Consider a relation R(A, B, C, D, E, F, G) with FDs and MVDs {A→→B, B→→G, B→→EF, CD→E}. Decompose this relation into a collection of 4NF relations if it is not in 4NF. **(3M+3M)**

3. Consider the following scheme of a hotel database with relations
   Hotel (Hotel_id, Hotel_name, location)
   Rooms (Hotel_id, Room_no, type, rent)
   Booking (Hotel_id, Room_no, Tourist_id, Entry_date, Departure_date)
   Tourist (Tourist_id, Tourist_name, Tourist_city)
   Express the following queries in **Relational Algebra and SQL**:
   a. Display the vacant room numbers of Hotel Park at Kharagpur on 19.2.2018
   b. Display the name of tourists who have stayed in all hotels located in Kharagpur
   c. Find the name of the hotel whose deluxe type room rent is highest. (2×3=6M)

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4. a. Suppose we have two relations R(A, B, C)and S(A, B, D). Show how natural join of R and S can be computed using fundamental operators of relational algebra. Write the corresponding expression in tuple relational calculus.

   b. State decomposition axioms for functional dependency. Given a relational scheme R(W, X, Y, Z), prove or disprove the rule : XZ→Y, X→W and Z ⊆ W imply X→Y. (3M+3M)

5. a. Explain the important features which distinguish a database system from a collection of conventional data files.

   b. Define the terms lossless join decomposition and preservation of dependencies. Explain their importance in the decomposition process of a relational scheme with justification.

   c. For a relational scheme, a set of FDs are given. Write an algorithm to check whether one FD from the given set of FDs is redundant or not. (2M+2M+2M)

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