Department of Mathematics
I.I.T., Kharagpur
Mid Spring Semester Examination 2019-2020
Subject: File Organization & Database Systems (MA40004/MA61018/MA60050)
4th Yr. B.Tech., 4th Yr. M.Sc., 1st Yr. M.Tech (CSDP)
No. of Students (154)

Time: 02 Hours **Marks: 30**

Answer all **FIVE** Questions
(This question paper consists of **TWO** Pages)

1. Assume we have the following applications that model football teams, the games they play and the players in each team. In the design, we want to capture the following:
   - We have a set of teams, each team has an ID (unique identifier), name, main stadium and to which city this team belongs.
   - Each team has many players and each player belongs to one team. Each player has a number (unique identifier), name, DOB, start year, jersey number that he uses.
   - There are a host team and guest team in each match. The match takes place in the stadium of the host team.
   - For each match, we need to keep track of the following:
     - The date on which game was played.
     - The final result of the match.
     - The players participated in the game. For each player, how many goals he scored, whether or not he took a yellow card or red card.
     - During the match, one player may substitute another player. Capture this substitution and its time.
   - Each match has exactly three referees. Each referee has an ID (unique identifier), name, DOB, years of experience. One of them is the main referee and the other two are assistant referees.

   a) Design an ER diagram to capture the above requirements. State any assumptions you made during the design process. Clearly indicate different type of relationships among sets.
   b) Write the relational model corresponding to the ER model obtained in (a) above. Indicate primary key and foreign key of each table.
   c) Draw the network model corresponding to the ER model obtained in (a) above.
   d) How many-many relationship is implemented in hierarchical data model.

   (3+1+1+1)

2. Suppose you are given a relation $R(A, B, C, D, E)$ with FD's $\{CE \rightarrow D,\ D \rightarrow B,\ C \rightarrow A\}$
   (i) Find all candidate Keys.
   (ii) Identify the best normal form (1NF, 2NF, 3NF or BCNF) that satisfies R.
   (iii) If the relational is not in BCNF, make a BCNF decomposition of R.

   (2+2+2)

P.T.O.

3.

a) Suppose you are given a relation $R(A, B, C, D, E)$ with the following FD's $\{BD \rightarrow E, A \rightarrow C\}$. The relation R decomposed into two sub relations $R_1(A, B, C)$ and $R_2(D, E)$. Test whether the decomposition satisfies lossless join and preservation of dependency property or not. Justify your answer with proper example.

b) Write an algorithm for decomposing a relational scheme into 3NF.

c) What is multi-valued dependency? What type of constraints does it specify? Explain with example.

(3+2+2)

4. What is the difference between Natural Join and Cartesian product?
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 operations of relational algebra. Write also the corresponding expression in tuple relational calculus.

(4)

5. Consider the relational scheme:
Teacher (*t_name, dept_no*)
Subject (*S_title, credit*)
Student (*Roll_no, S_name, course, hall*)
Taught_by (*t_name, S_title*) and
Taken_by (*S_title, Roll_no, status, marks*)

a) Express the following queries in **tuple relational calculus**:
(i) Find the name of students of RP hall who study the subject with title 'DBMS'.
(ii) Find the students of CSDP course and living in RP hall who study no subject taught by Prof. XYZ.

b) Express the following queries in **Relational Algebra**:
(i) Find the name of students of 'CSDP' course who study 'DBMS' as a core subject and find their marks.
(ii) Find the name of students who secured equal marks in two different subjects.
(iii) Find the name of student(s) who secured highest marks in the subject 'DBMS'.

(2+5)

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