

B. Math III Year Final Examination – CS IV
(Max. marks 50, weight 50%, and Time 3 hours)

Note: Wherever required, follow the ANSI SQL syntax conventions we studied.

Q1 [10 Marks – 1 Mark each] Fill in the blanks, Short answers, or True/False

- a. The three principal components of a database management system are _____, _____, and Storage manager.
- b. What is a weak entity set?
- c. We use _____ relationship to indicate that one entity set is a special set of another entity set.
- d. When two sets of attributes in a relation have sets of values which appear in all combinations then the relation is said to have _____
- e. The _____ type of a model restricts relationships to binary and many-one.
- f. A _____ along with the _____ of that relation form the relation schema.
- g. (State True/False) While converting an entity set into a relation, all its attributes completely define the relation
- h. What is the main advantage of BCNF?
- i. A _____ model has _____ relationships from child to parent.
- j. If relation R has n tuples and relation S has m tuples, what is the maximum number of tuples that R – S can contain?

Q3 [10 Marks]

- a. [2 Marks] Claim: Every relation with only two attributes is necessarily in BCNF. Give a counter example to show that this claim is false.
- b. [3 Marks] Convert the relational algebra expression $R \setminus S$ into SQL, without using the SQL commands INTERSECT and EXCEPT.
- c. [2 Marks] How many non-trivial multi-valued dependencies are possible in a three-attribute relation?
- d. [3 Marks] You are given the following relations: ISI_Students (Student_ID, Course_ID) Required_B_Math_Courses (CourseID). The ISI_Students relation lists IDs of all the ISI students and IDs of courses taken by them. The Required_B_Math_Courses relation lists the courses every BMath student must take to graduate. Write a single query that finds the students who have taken all the required courses for graduation.

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Q3 [30 Marks] The governing body of world cricket (ICC) may have the following database schema. The schema definition also includes in {} representative values for some of the attributes. You can make reasonable assumptions for the values of the remaining attributes. The description also mentions the approximate number of tuples in each relation. Study the schema before answering questions.

| # | Relational schema | Brief description |
|-----|--|---|
| 1. | Players (<u>PID</u> , Gender, Name, Country, Born_on, Died_on, Retired{Y,N}) | Basic information on players. 150,000 tuples |
| 2. | Umpires (<u>UID</u> , Gender, Name, Country, Currently_busy{Y,N}, Born_on, Died_on, Retired{Y,N}) | Describes umpires. 500 tuples |
| 3. | Venue (<u>VID</u> , City, Country, Lights{Y,N}) | Describes match grounds. 1,000 tuples |
| 4. | Sides (<u>SID</u> , Side_Name, Country) | Describes various sides such as India, Victoria, Railways etc. 500 tuples |
| 5. | Match (<u>MID</u> , Match_Type{Test, One-day, Others}, VID, Side1_ID, Side2_ID, Result{Decided, Draw, Tie }, Winning_Side_ID, Umpire1_ID, Umpire2_ID, Umpire3_ID, Match_Start_Date, Match_End_Date) | Stores basic information on every international match. 20,000 tuples |
| 6. | Match_Players (<u>MID</u> , <u>PID</u> , Twelfth_Man{Y,N}) | Stores information on which players played in a match. 200,000 tuples |
| 7. | Match_Summary_Stats(<u>MID</u> , <u>Innings</u> {1,2,3,4}, Batting_Side_ID, Runs, Wickets) | Stores summary statistics for every international match. 75,000 tuples |
| 8. | Match_Batting_Detailed_Stats(<u>MID</u> , <u>Innings</u> {1,2,3,4}, <u>PID</u> , Mode_of_Dismissal, Bowler_ID, Runs_Scored, Minutes_Played, Balls_Faced, Fours, Sixes) | Stores detailed statistics for the batting in every international match. 750,000 tuples |
| 9. | Match_Bowling_Detailed_Stats(<u>MID</u> , <u>Innings</u> {1,2,3,4}, <u>PID</u> , Overs_Bowled, Maiden_Overs, Runs_Given, Wickets_Taken) | Stores detailed statistics for the bowling in every international match. 750,000 tuples |
| 10. | Player_Batting_Stats (<u>PID</u> , <u>Match_type</u> , Total_Matches_Played, Total_Innings_Played, Total_Runs_Scored, Highest_Score, Average_Score, Catches_Taken, Stumpings_Made) | Batting statistics for the players. 300,000 tuples |
| 11. | Player_Bowling_Stats (<u>PID</u> , <u>Match_type</u> , Matches, Total_balls, Runs_Given, Wickets_Taken, Best_Effort {8 for 103, 7 for 48}, Average, Economy_Rate) | Bowling statistics for the players. 150,000 tuples |

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The questions below refer to the above relations. Please note that there may be multiple ways (unless the question specifies one) to arrive at an answer and you are expected to use the most efficient approach by taking into account the number of tuples.

- a. **[3 Marks]** A new match between West Indies and India is coming up and ICC wants to select neutral umpires (i.e. not from either West Indies or India) from those who are currently not busy. Write a query that will give ICC a list to choose from.
- b. **[3 Marks]** Write a query that will give the name of the current female player who has the highest batting average.
- c. **[3 Marks]** Write a query making use of the subqueries to get the names of all male players who have been twelfth men in test matches but have never played a test match in the playing 11.
- d. **[3 Marks]** Write a relational algebraic expression to get a list of names and the date of birth of people who died after Jan-1-2000
- e. **[3 Marks]** Show a query that will list in descending order of the highest innings scores and the side that scored them provided no more than 3 wickets were lost.
- f. **[3 Marks]** Write a relational algebraic expression to get a list of venues (by countries) which have not yet hosted a one-day international match.
- g. **[3 Marks]** Write a query that will get the name(s) of the dead Indian male player who scored the highest runs in a test innings.
- h. **[3 Marks]** Write a query that will get the name(s) of the retired female player who has bowled maximum maiden overs in a one-day match and has taken at least 2 wickets.
- i. **[3 Marks]** Write a query to get the total number of test runs scored by all Indian players who are retired.
- j. **[3 Marks]** Write a query to get a list of top retired all-rounders of the one-day cricket by countries. We can assume that an all-rounder is someone who has a batting average more than 35 and a bowling average less than 25.