

# Master of Computer Applications

MCAC 202: Database Systems

Unique Paper Code: 223401202

Semester II

August-2022

Year of admission: 2021

Time: Three Hours

Maximum marks: 70

Note: Answer all the questions. Each questions carry equal marks.

1. Delhi Transport Corporation owns a number of buses.

- Each bus is allocated to a particular route, although some routes may have several buses.
- Each route passes through a number of towns.
- One or more drivers are allocated to each stage of a route, which corresponds to a journey through some or all of the towns on a route.
- Some of the towns have a garage where buses are kept and each of the buses are identified by the registration number and can carry different numbers of passengers, since the vehicles vary in size and can be single or double-decked.
- Each route is identified by a route number and information is available on the average number of passengers carried per day for each route.
- Drivers have an employee number, name, address, and sometimes a telephone number.

Construct an E-R diagram that models the above scenario. Translate your ER -diagram into Relational Schema. [10]

2. Consider the following set F of functional dependencies on the relation schema  $R(A, B, C, D, E, G)$ .

$$F = \{AD \rightarrow E, BE \rightarrow F, B \rightarrow C, AF \rightarrow G\}$$

- (a) What are the candidate keys of R? [4]
  - (b) Provide a BCNF decomposition for  $R(A, B, C, D, E, G)$ . Show your steps and your decomposition tree. [4]
  - (c) Is your answer to Question 2(b) is dependency preserving decomposition? Justify your answer. [2]
3. (a) In the process of using functional dependencies to normalise a schema, what is meant by a lossless join decomposition and how is such a decomposition guaranteed? [2]
- (b) Suppose that relation R has  $m$  attributes. Give an upper bound on the number of functional dependencies that R could satisfy (including trivial dependencies). [3]
- (c) Let  $R(A, B, C, D, E)$  be a relational scheme with the following dependencies.

$$F = \{A \rightarrow C, BC \rightarrow D, A \rightarrow E, BD \rightarrow C, C \rightarrow E, E \rightarrow D, E \rightarrow B\}$$

Which, if any, of these dependencies are redundant? [5]

4. We are interested in storing basic information about Indian Premier League (IPL) as per the following specifications.

IPL has many teams and each team has a *name*, a *city*, a *coach*, a *captain*, and a *set of players*. Each player belongs to only one team and has a *name*, a *batting position* (such as *top order*, *middle order* or *tail enders*), a *role* (*batsman*, *bowler* or *Allrounder*), 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*. The performance of each player has to be recorded, i.e., the *number of wickets* and *runs scored*.

- (a) Write a simple Document Type Definition (DTD) for this application. [7]
- (b) Write XQuery code to display the detail of players who have taken more than 30 wickets. [3]

5. (a) For each of the following schedules, determine whether the schedule is conflict serializable.  $R_i(A)$  indicates a read by transaction  $T_i$  on data item  $A$ .  $W_i(A)$  indicates a write by transaction  $T_i$  on data item  $A$ . [6]

- (i)  $R_1(A); W_2(B); R_2(A); W_1(B); W_3(B); W_1(C); R_3(B); W_1(A)$   
 (ii)  $W_2(C)R_1(A)W_3(B)R_1(C)R_3(B)R_3(A)W_1(B)$   
 (iii)  $W_2(C)R_1(A)W_3(B)R_1(C)R_3(B)R_3(A)W_1(B)$   
 (iv)  $W_1(A)W_2(B)W_1(B)W_2(A)$

- (b) Draw the waits-for graph and mark all the transactions that are involved in a deadlock for the following schedule. If there is no deadlock, mark No Deadlock. Note that the RS indicates a request for a shared lock on a page, and RX indicates a request for an exclusive lock on a page. No transactions commit or abort during this time. [4]

T1	RS(D)							RX(D)	
T2		RS(A)							RS(C)
T3			RS(D)	RX(B)	RX(A)				
T4						RX(C)	RS(B)		

6. (a) Explain why it is not always possible to perform SQL UPDATE/DELETE/INSERT statements on top of a view. [2]

- (b) List two reasons why *null* values might be introduced into the database. [2]

- (c) Write the tuples that will be contained in R after executing the following code. [2]

```
CREATE TABLE T(C INT PRIMARY KEY, D INT);
CREATE TABLE S(B INT PRIMARY KEY, C INT, FOREIGN KEY(C) REFERENCES T(C) ON DELETE CASCADE);
CREATE TABLE R(A INT PRIMARY KEY, B INT, FOREIGN KEY(B) REFERENCES S(B) ON DELETE SET NULL);
INSERT INTO T VALUES (1, 1), (2, 1);
INSERT INTO S VALUES (1, 1), (2, 1);
INSERT INTO R VALUES (1, 1), (2, 2);
DELETE FROM T;
```

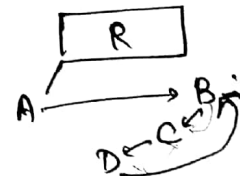
- (d) Consider the relational schema: *course(course, dept\_name)* and *enroll(studentID, course)* [4]

- (i) Write a SQL query to find the ID's of all students who are not enrolled in any courses in the CS department. Do not use the SQL except operator.

- (ii) Write a SQL query to find the names of all departments that offer at least 20 courses.

7. (a) Initially, user A is the owner of relation R, and no other user holds privileges on R. The following SQL statements are executed:

by A: GRANT INSERT ON R TO B WITH GRANT OPTION;  
 by B: GRANT INSERT ON R TO C WITH GRANT OPTION;  
 by C: GRANT INSERT ON R TO D WITH GRANT OPTION;  
 by D: GRANT INSERT ON R TO B WITH GRANT OPTION;  
 by B: REVOKE INSERT ON R FROM C CASCADE;



As a result, which is the exact set of users that have the privilege INSERT ON R? [2]

- (b) Consider the following relations:

Student(snum: integer, sname: string, major: string, level: string, age: integer)

Class(name: string, meets\_at: string, room: string, fid: integer)

Enrolled(snum: integer, cname: string) → class name

Faculty(fid: integer, fname: string, deptid: integer)

Write a SQL query to

- (a) find the age of the oldest student who is either a History major or enrolled in a course taught by Vikas. [2]

- (b) find the names of all students who are enrolled in two classes that meet at the same time. [2]

- (c) find the names of faculty members who teach in every room in which some class is taught. [2]

- (d) for each faculty member that has taught classes only in room R128, print the faculty member's name and the total number of classes she or he has taught. [2]