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Master of Computer Applications  
MCAC 104: Database Systems  
Unique Paper Code: 223421113/ 223421104  
Semester I  
December 2024  
Year of Admission: 2023, 2024

Time: 3 hours

Maximum Marks: 70

Note: Parts of a question should be answered together. Attempt all questions.

1. a. Consider the relation and the functional dependencies (FDs) given below:

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**EMPLOYEE PROJECT**

<u>EmployeeID</u>	<u>ProjNumber</u>	<u>EmployeeName</u>	<u>ProjName</u>	<u>ProjLocation</u>
101	P1	Suresh	Inventory	Delhi
102	P2	Ramesh	E-Commerce	Mumbai
103	P1	Suresh	Inventory	Delhi
104	P3	Jitesh	Payroll	Noida

FDs:

$$\begin{aligned} EmployeeID &\rightarrow EmployeeName \\ ProjNumber &\rightarrow ProjName, ProjLocation \end{aligned}$$

Which of the following operations would result in insert/update/delete anomalies? Justify your answer.

- i. Change the project location for ProjNumber = 'P1' from Delhi to Chandigarh.
- ii. Add a new project (ProjNumber = 'P4', ProjName = 'Chatbot', ProjLocation = 'Chennai')
- iii. EmployeeID = 104 (Jitesh) is removed.

- b. Consider the following relations containing airline flight information (keys are underlined): 8

Flight(Flight No, From, To, Distance, Depart Time, Arrival Time, AircraftId)  
Aircraft(AircraftId, Aircraft Name, Range)  
Certified(PilotId, AircraftId).  
Pilot(PilotId, Pname, Salary).

Note that pilots can fly only those aircrafts which they are certified to fly. Write relational algebra expressions to perform the following:

- i. Find PilotIds of pilots who are certified to fly all aircrafts having range more than 3000.

- ii. Find the names and salaries of pilots certified to fly aircrafts assigned to flights traveling over 1000 miles.
- iii. List all flights operated by aircrafts with the name "Boeing 747".
- iv. List all pilots along with the aircrafts they are certified to fly.

2.  Describe the three-schema architecture with the help of a suitable diagram. Differentiate 6 between logical data independence and physical data independence.

b. Consider two concurrent transactions,  $T_x$  and  $T_y$ , executing simultaneously involving read and write operations on the data item A. The initial value of A is set at 500. For each scenario, identify the problem(s) that could arise. Justify your answer. 4

i.	Time	$T_x$	$T_y$
	$t_1$	READ(A)	-----
	$t_2$	$A = A + 50$	-----
	$t_3$	WRITE(A)	-----
	$t_4$	-----	READ(A)
	$t_5$	SERVER DOWN ROLLBACK	-----

ii.	Time	$T_x$	$T_y$
	$t_1$	READ(A)	-----
	$t_2$	$A = A - 50$	-----
	$t_3$	-----	READ(A)
	$t_4$	-----	$A = A + 100$
	$t_5$	-----	-----
	$t_6$	WRITE(A)	-----
	$t_7$	-----	WRITE(A)

c. Consider the following relation schema and set of functional dependencies (FDs):

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**Relation Schema:**

$R(A, B, C, D, E)$

**Functional Dependencies:**

$A \rightarrow B$

$B \rightarrow C$

$CD \rightarrow E$

$E \rightarrow A$

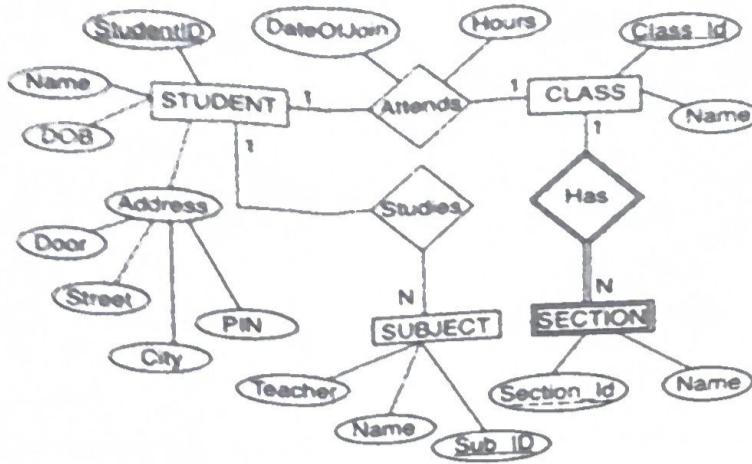
Using Armstrong's Axioms, whether the following functional dependency holds or not.

i)  $AC \rightarrow E$

ii)  $C \rightarrow A$

3. a) Consider the following Entity Relationship Diagram (ERD) for the UNIVERSITY database:

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- Map the ERD into relations considering different entity types, relationships, attributes, and constraints.
- Identify the primary key and foreign key of each relation.

b) Consider the following two sets of functional dependencies:

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

Check whether they are equivalent.

c) Explain the following constraints in the context of the enhanced entity-relationship (EER) model with the help of suitable examples:

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- Disjoint Constraint
- Completeness Constraint

4. a) Consider the following relation for published books:

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**BOOK** (Book\_title, Author\_name, Book\_type, List\_price,  
Author\_affil, Publisher)

Author\_affil refers to the affiliation of author. Suppose the following dependencies exist:

*Book\_title* → *Publisher*, *Book\_type*

*Book\_type* → *List\_price*

*Author\_name* → *Author\_affil*

i. What normal form is the relation in? Explain your answer.

ii. Apply normalization until you cannot decompose the relation further. Justify each step.

b) Consider the following relation schema:

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**Student** (SSN, Name, Major, Birthdate)  
**Course** (CourseId, CourseName)  
**Enroll** (SSN, CourseId, Duration)

Which of the relational model constraints may be violated by the following operations? Justify your answer.

- i. Insert a record in the **Enroll** table.
- ii. Delete a record from the **Student** table.

c. Illustrate the concept of relational schema and relational state with the help of a suitable example. 2

5. a. Draw an Entity Relationship Diagram (ERD) for the following case study: 8

Consider the domain of XYZ College. There are teachers teaching the courses in the college. Each teacher is identified by a unique Teacher\_ID and may teach up to four courses. Along with Teacher\_ID, a teacher has attributes such as Name, Department, Qualification, and Contact. Every course is taught by exactly one teacher. A course is identified by a unique Course\_ID and is further described by its Title, Credits, Semester, and the Teacher\_ID of the teacher who teaches it. A set of books is defined for use in the college. Each book is identified by a unique Book\_ID and is further described by its Title, Author, Edition, and ISBN. A course may use between zero and five books, and a book may be used by at most one course. If a book is listed, it is always allocated to some course and can only be associated with one course. A book allocated to a course can be authored by single or multiple authors.

The ERD should include all the entities and relationships mentioned in the case study. Suitable attributes may be assumed for each entity and relationship.

The following ER constructs should be depicted:

- A composite attribute (if any)
- A multi-valued attribute (if any)
- A derived attribute (if any)
- Cardinality ratios and Total/partial participation constraint using (min, max) notation.

b. Consider the following tables: 6

EMPLOYEE

employeeID	employeeName
E101	Rohit Sharma
E102	Virat Kohli
E103	Hardik Pandya
E104	Rahul Dravid

PROJECT

projectNo	projectName
P101	Project A
P102	Project B
P103	Project C

**ASSIGNMENT**

<b>employeeID</b>	<b>projectNo</b>
E101	P101
E101	P102
E101	P103
E102	P101
E102	P102
E103	P101
E103	P103

Write SQL queries to perform the following operations:

- i. Find the **project numbers** and **names** of projects that have no employees assigned to them.
- ii. List the **employee names** and the **names of projects** they are assigned to, sorted by **employee name**.