King Fahd University of Petroleum and Minerals

Department of Information and Computer Science

ICS 324: Database Systems

Spring 2007-2008

Date: 5-May-2008 | **Major Exam II: Relational Model & Relational Database Languages** | **Time Slot:** 6:30 p.m. – 8:00 p.m.

Duration: 90 minutes | **Total Points:** 150

Name:	**Student ID #:**

Notes:

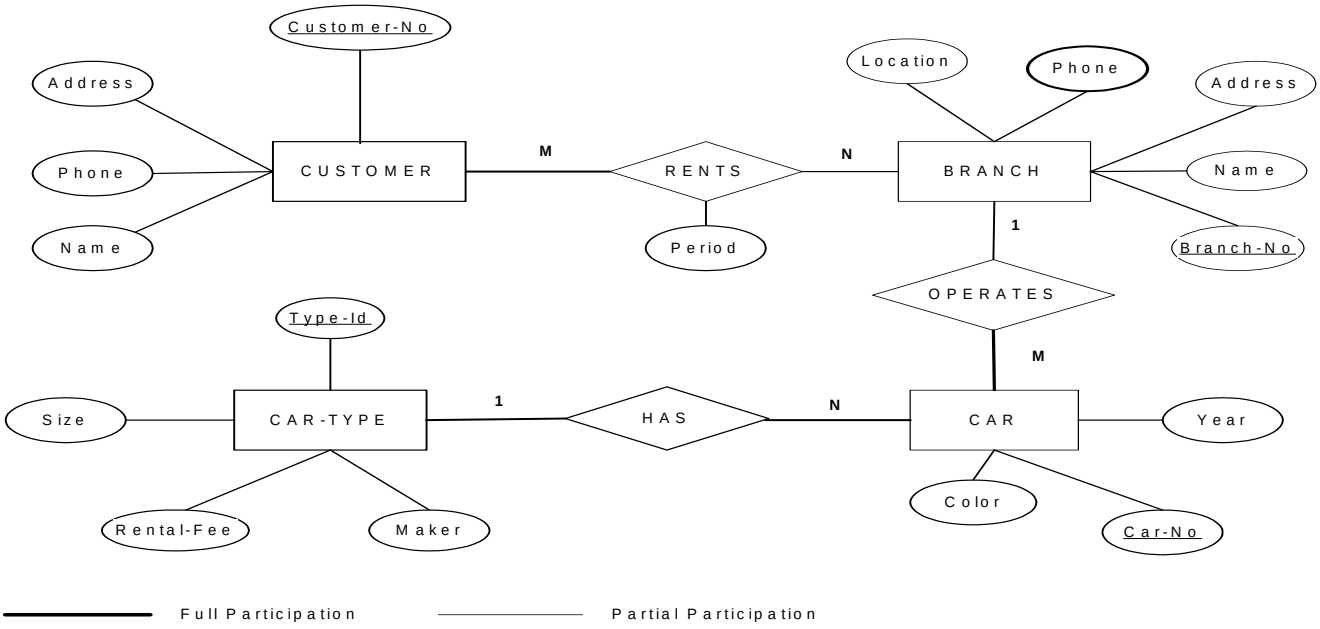
- Please skim through all the questions, make sure that you understand them, and then attempt to answer them with a time-allocation in mind. If any question is not clear, get it clarified during the first fifteen minutes.
- If you need to make any assumptions, please document them as part of your answers.
- There are **four** questions in this exam each focusing on a distinct aspect. You are expected to answer all of them.

Scores:

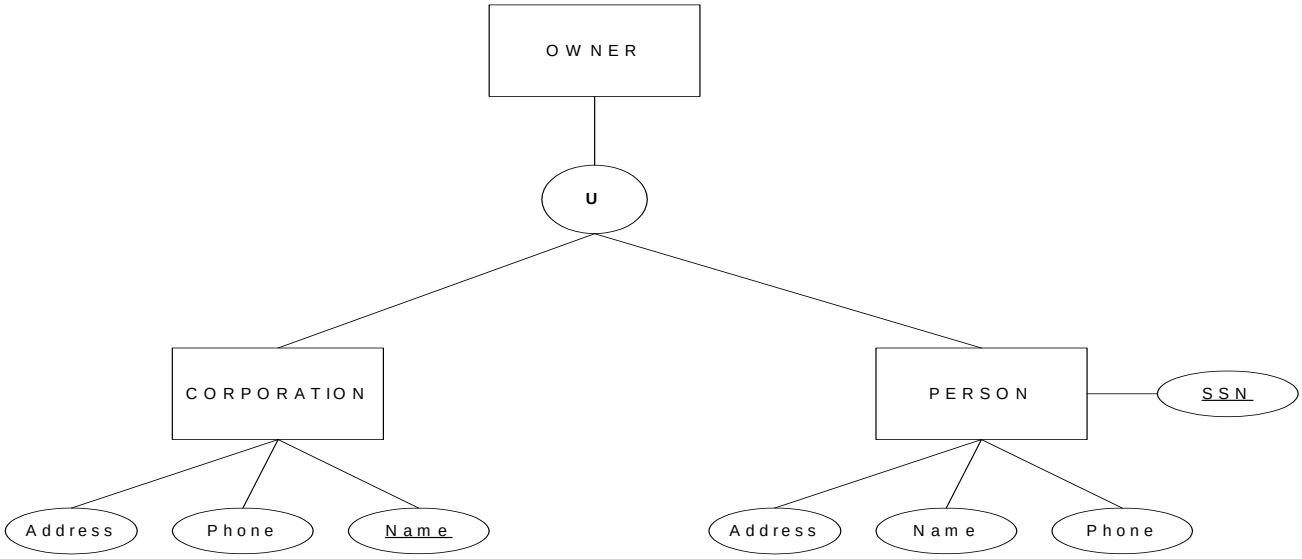
Problem	**Points**	**Score**
Question 1: ER & EER-to Relational Mapping	**45**	
Question 2: Relational Algebra	**35**	
Question 3: Relational Calculus and Update Operations	**35**	
Question 4: SQL	**35**	
Total➔	**150**	

1. [ER & EER to Relational Mapping] **(45 points)**

a) Given the ER diagram below for a rental car company, design the corresponding relational database schema. Show the details of your work for each table in the schema. **(30 points)**



b) Map the following EER schema into relational schema. For full mark you must explain your work in detail. **(10 points)**



c) Assume that you have m subclasses $\{S_1, S_2, \ldots, S_m)$ of a supper class C with attributes $\{k, A_1, A_2, \ldots, A_n\}$where k is the primary attribute and both total and disjoint constraints hold. Briefly explain how this class-subclass schema can be mapped into relational model using multiple relations. **(5 points)**

2. [**Relational Algebra]** **(35 points)**

a) Consider the following relations R and S. Determine the result of the specified relational algebra operations in parts i, ii and iii below: **(15 points)**

R	A	B	C
	1	2	3
	4	6	6
	7	8	9

S	B	C	D
	2	3	10
	2	3	11
	6	7	12

i. Natural join: R * S

ii. Left Outer join: $R \ ⟕ \ S$

iii. Cartesian Product: $\pi_{C}(S) \times (\sigma_{A=1}(R))$

iv. Aggregate function with grouping: $_{B, C}\mathcal{G}_{\texttt{SUM D}}(S)$

b) Assume a database about college attendance. Write relational algebra expressions to answer each of the queries i, ii and iii below: (**20 Points**)

```
EMPLOYEE   (Emp#, Name, Salary)
COLLEGE    (Col#, Name, Location)
ATTENDS    (Emp#, Col#, GPA)
```

i. Find the names and locations of the colleges being attended by employees with a salary greater than 5000.

ii. Find the names and numbers of those employees who do not attend in any college.

iii. Find the names and numbers of those employees who attend all the colleges.

3. [Relational Calculus and Update Operations] (35 points)

a) Consider the Library relational schema shown below. Write Tuple Relational Calculus expressions for queries i, ii and iii below: **(16 Points)**

BOOK

BkId	Title	PubName

PUBLISHER

PubName	Address	Phone

AUTHORS

BkId	AName

COPIES

BkId	BrId	No-Of-Copies

BRANCH

BrId	BrName	Address	Phone

i) For each author retrieve the name and the number of books he authored.

ii) How many copies of the book titled 'Database Systems' are owned by the library branch whose name is 'CCSE'.

iii) For each book published by 'McGraw Hill' list the book number, book title, author name and the number of copies

b) Rewrite only two of the above queries using Domain Relational Calculus. **(10 Points)**

c) Given the relational database instance below, answer parts i, ii and iii below: **(9 Points)**

BOOK	CODE	TITLE	AUTHOR	YEAR
	ICS1	Databases	Ullman	1990
	ICS2	Data Structures	Knuth	1987
	ICS3	AI	Rich	1986
	ICS4	Logic	Manna	1986

OWNER	BCODE	NAME	PHONE
	ICS1	Maghrabi	4698
	ICS2	Najjar	3345
	ICS4	Ghanta	2356
	ICS3	Maghrabi	4698

i) Indicate whether the following update operation is acceptable or not, and if not why not:
Insert the tuple < 'ICS1', 'Mulhem', 2175 > into OWNER.

ii) Give an example of a delete operation on Book that is not acceptable and state why.

iii) Give an example of an update operation on OWNER that is acceptable.

4. [SQL] **(35 points)**

a) Consider the following relational database instance. What will be produced by the SQL queries in parts i, ii and iii below: (**12 Points**)

Hotel

Hotel-No	Name	Address
H1	Meridian	Khobar
H2	Sheraton	Dammam

Room

Room-No	Hotel-No	Type	Price
R1	H1	Single	300
R2	H1	Double	400
R3	H1	Single	350
R1	H2	Double	500
R2	H2	Single	350
R3	H2	Double	400

Booking

Hotel-No	Guest-No	Date-From	Date-To	Room-No
H2	G1	Nov. 20, 2001	Nov. 22, 2001	R1
H2	G3	Jan. 1, 2001	Jan. 5, 2001	R2
H1	G4	Jan 3, 2002	Jan 5, 2002	R1
H1	G2	Dec. 21, 2001	Dec. 30, 2001	R3

Guest

Guest-No	Name	Address
G1	Ahmad Ali	Jeddah
G2	Mohammad Kamel	Taif
G3	Ali Barakat	Mekka
G4	Said Khaled	Madina

i. SELECT *

FROM Room

WHERE Type = ‘Single’ AND Price > 300.

ii. SELECT Name, Address

FROM Guest G, Booking B

WHERE G. $_{\text{Guest-No}}$ = B. $_{\text{Guest-No}}$ AND B. $_{\text{Date-From}}$ >= ‘Jan. 1, 2002’)

iii. SELECT Type, Price

FROM Room R, Guest G, Booking B

WHERE R.$_{\text{Hotel-No}}$ = B.$_{\text{Hotel-No}}$ AND R.$_{\text{Room-No}}$. = B.$_{\text{Room-No}}$ AND G.$_{\text{Guest-No}}$. = B.$_{\text{Guest-No}}$ AND G.$_{\text{Name}}$ = ‘Mohammed Kamel’)

b) Using SQL, create a view, Guest_View, which will display the names of the guests occupying the rooms, with the room number, in the Meridian Hotel. (**8 points**)

c) Consider the following relational schema, Write SQL queries for parts i, ii and iii below: (**15 Points**)

```
SUPPLIERS  (Sid, Sname, Address)
PARTS      (Pid, Pname, Color)
CATALOG    (Sid, Pid, Cost)
```

i. Find the sids of suppliers who supply some red part and some green part.

ii. Find pairs of sids such that the supplier with the first sid charges more for the same part than the supplier with the second sid.

iii. Find the pids of parts that are supplied by at least two different suppliers.