

King Fahd University of Petroleum and Minerals  
Department of Information and Computer Science

ICS 324: DATABASE SYSTEMS  
TERM 062

Time Allowed: 120 Minutes

Student ID: \_\_\_\_\_

Name: \_\_\_\_\_

Section:  01  02  03 (Check your Section)

Problem	Points	Score
Q 1: Basic Concepts	20	
Q 2: Conceptual Database Design	20	
Q 3: EER Modeling	20	
Q 4: Logical Database Design	20	
Q 5: Relational Languages	20	
<b>Total</b>	<b>100</b>	

**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.

April 23, 2007

**Q1. [Basic Concepts – (20 points)]**

**a.**

(i) Briefly describe the **three** basic components of the Entity-Relationship Model. For each component outline two of its types: **(6 Points)**

(ii) Briefly describe the difference between the *cardinality* constraints and the *participation* constraints between relationships. **(4 Points)**

**(b)** Briefly describe how the following ER model constructs are mapped into constructs in the *relational model* **(4 Points)**

1) Multivalued attributes of a regular entity type E

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2) 1:N relationship R between entity type E1 and E2

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(c) If R, S, T are relations then state whether each of the following statement, in general, is True (T) or False. (F) (6 Points)

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|---|-----|
| 1. $(\sigma_{\langle SC \rangle} (\pi_{\langle AL \rangle} (R))) \equiv (\pi_{\langle AL \rangle} (\sigma_{\langle SC \rangle} (R)))$ | T F |
| 2. S and R has to be union compatible in order to have $S \times R$ .   | T F |
| 3. $R \times_{\langle SC \rangle} S \equiv (\sigma_{\langle SC \rangle} (R \times S))$  | T F |

**Q2. [Conceptual Database Design – (20 points)]**

*Develop an ER diagram for the following problem.*

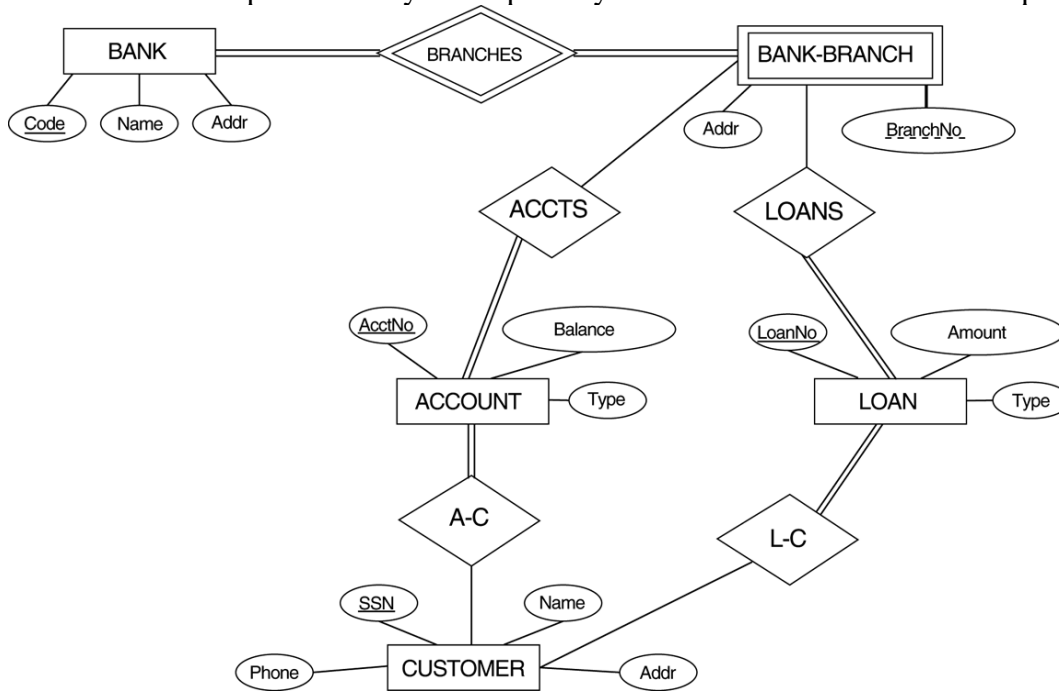
A company purchases items from a number of different vendors, who then ship the items to the manufacturer. The items are assembled into products that are sold to customers who order the products. Each customer order may include one or more lines corresponding to the products appearing in that order.

The following points may clarify the understanding of the problem.

- i. A supplier may supply many items (by ‘may supply’ we mean that the supplier may not supply any items). Each item is supplied by any number of suppliers (by ‘is supplied’ we mean must be supplied by at least one supplier)
- ii. Each item must be used in at least one product, and may be used in many products. Conversely, each product must use one or more items.
- iii. A supplier may send many shipments. On the other hand, each shipment must be sent by exactly one supplier.
- iv. A shipment must include one (or more). An item may be included on several shipments.
- v. A customer may submit any number of orders. However, each order must be submitted by exactly one customer.
- vi. An order must request one (or more) products. A given product may not be requested on any order, or may be requested on one or more orders.

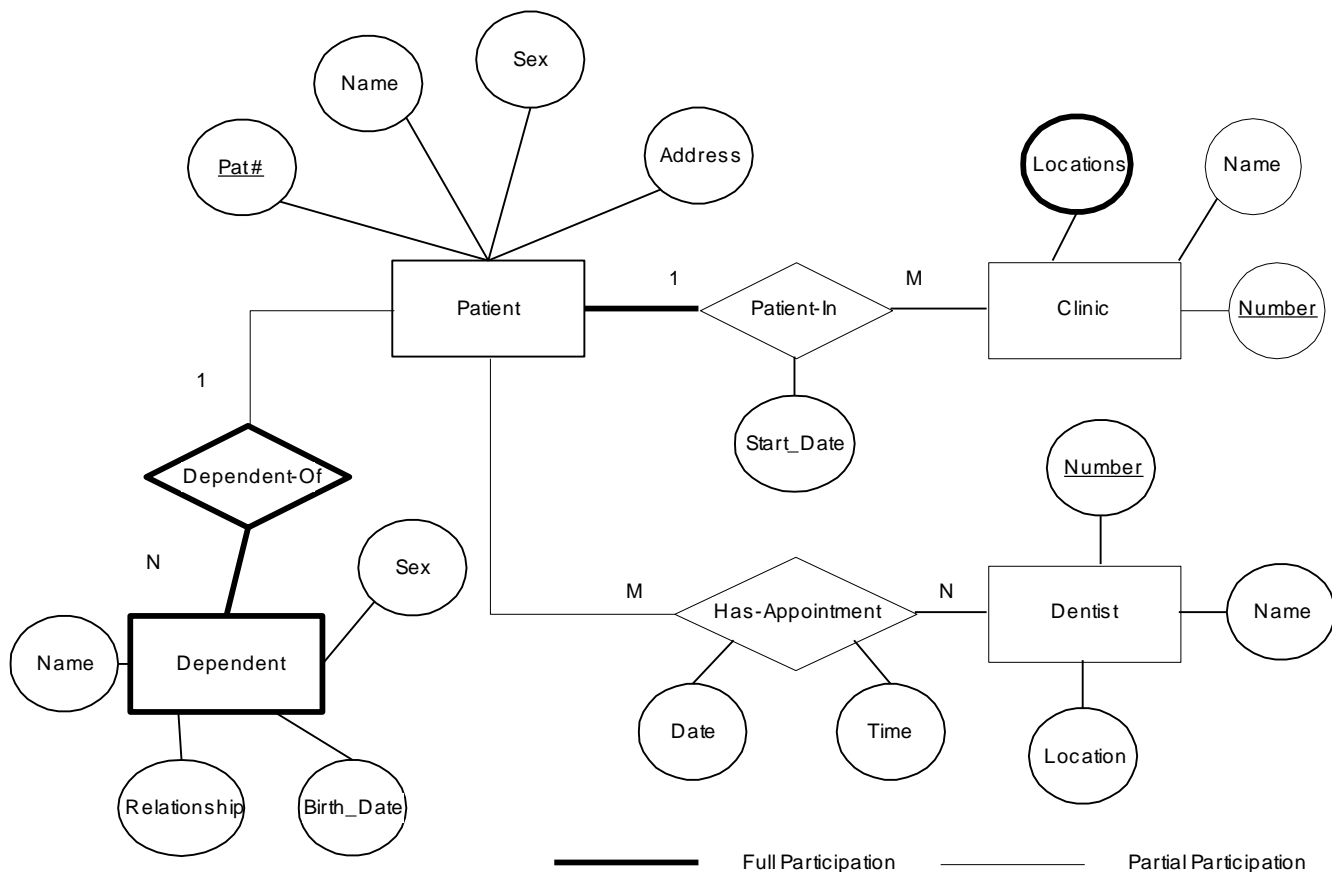
**Q3. [EER Modeling – (20 points)]**

- What is the difference between specialization and generalization? Why do we not display this difference in schema diagram? **(10 points)**
- Following is an ER diagram of a bank database. Suppose that it is necessary to keep track of different types of accounts (savings, checking, ...) and loans (car-loan, home-loan, ...). Suppose that it is also desirable to keep track of each account's transactions (deposits, withdrawals, checks, ...) and each loan's payments; both of these include the amount, date, time, ... Modify the diagram using EER concepts. State any assumptions you make about the additional requirements. **(10 points)**



**Q4. [Logical Database Design – (20 points)]**

Below find an ER diagram representing the conceptual design of a database system for a Dental Center Use the procedure (Approach One) in the handout distributed to you in the class to develop the logical design for this database. In particular you are required to follow the steps of the procedure to convert the entities and relationships in this diagram into relational schema. (For complete marks you need to show your works in detail):



**Q5. [Relational Languages– (20 points)]**

Given the following relations:

**Hotel**

<u>Hotel-No</u>	Name	Address
H1	Meridian	Khobar
H2	Sheraton	Dammam

**Room**

<u>Room-No</u>	<u>Hotel-No</u>	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**

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

**Guest**

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

a) What will be produced by the following relational expressions? **(10 points)**

i)  $\pi_{\text{Type}} (\sigma_{\text{Hotel-No} = \text{'H1'}} \text{Room})$  **(3 points)**

ii)  $\pi_{\text{Room-No, Date-From}} (\text{Booking} \bowtie (\sigma_{\text{Guest-Name} = \text{'Ahmad Ali'}} \text{Guest}))$  **(3 points)**

iii)  $\pi_{\text{Name, Address}} (\text{Guest} \bowtie (\sigma_{\text{date-From} > \text{'Dec. 30'}} \text{Booking}))$  **(3 points)**

- b)** Write Relational Algebra expressions that answer the following queries. Wherever a join is required, Please mention it with joining conditions.
- i) Find all single rooms that cost more than SR300. **(3 points)**

- ii) Find the names and addresses of all guests who reserved rooms starting from or after 'Jan. 5' **(4 points)**

- iii) Find the type and price of the room that is reserved by 'Mohammad Kamel'. **(4 points)**