



MASENO UNIVERSITY
UNIVERSITY EXAMINATIONS 2017/2018

**SECOND YEAR FIRST SEMESTER EXAMINATIONS FOR THE
DEGREE OF BACHELOR OF SCIENCE IN INFORMATION
TECHNOLOGY MANAGEMENT**

MAIN CAMPUS

CIM 203: DATABASE SYSTEMS LAB

Date: 23rd February, 2018

Time: 3.30 - 6.30 pm

INSTRUCTIONS:

- Answer ALL questions in SECTION A and any other TWO from SECTION B
- Write your registration number on all sheets of the answer book used.
- Use a NEW PAGE FOR EVERY QUESTION attempted, and indicate number on the space provided on the page of the answer sheet.
- Fasten together all loose answer sheets used.
- Mobile phones and PDAs are NOT allowed in the examination room.



SECTION A (30 MARKS)
ANSWER ALL QUESTIONS IN THIS SECTION
SECTION A

QUESTION 1

- (a) A property management company has approached you to build a system that will help it keep track of its properties, tenants, and employees. Consider the following requirements and design a database conceptual schema to support such an application.

The property management company owns several buildings, each at a distinct address. Each of the buildings contains several apartments. All apartments in a given building are assigned an apartment number that is unique within that building (but not necessarily across different buildings).

The system should keep track of the number of bedrooms and number of bathrooms that each apartment has. The system also needs to handle different kinds of people. A person is identified by a unique SSN, and has a name consisting their first name and last name. Each person may have several phone numbers. People handled by the application fall into two disjoint categories: tenants and employees. For each tenant, it is necessary to record their bank account number for the purposes of deducting their rent. The application also needs to store the name and phone number of their next-of-kin for contact purposes in case of an emergency.

For each employee, the application needs to keep track of their monthly salary. Employees can be managers or technicians (or both). Each manager has an office located in one of the apartments, and is in charge of managing at least one building. All buildings must have a manager. For technicians, the application should keep a record of their skills, which is one or more of the following: "carpentry", "plumbing", "electrical".

To rent an apartment from the property management company, tenants must sign a lease agreement. A lease agreement is a formal contract by one or more tenants (as may be the case with roommates) to lease an apartment; it includes the start date and expected duration of occupation of the apartment, as well as the amounts for security deposit and monthly rent. The lease agreement is also countersigned by the manager in charge of the building, on behalf of the company.

Design an EER (Enhanced Entity Relation) conceptual schema (EER Diagram) based on the above specification, which accurately captures as much of the semantics of the application as possible. You should use the standard notation as discussed in class. Your EER diagram should include all relevant entities, attributes, relationships, cardinalities and specialization and generalization hierarchies. You may make and state in writing reasonable assumptions if they are not provided in the specification. (20 Marks)

- (b) Consider the following tables:

Book			
ISBN	Author	Title	Year
949	A.Green	Memoirs	2001
287	B.Black	Biology	2002

Publisher	
PublisherName	ISBN
Thompson	949
Elsevier	287

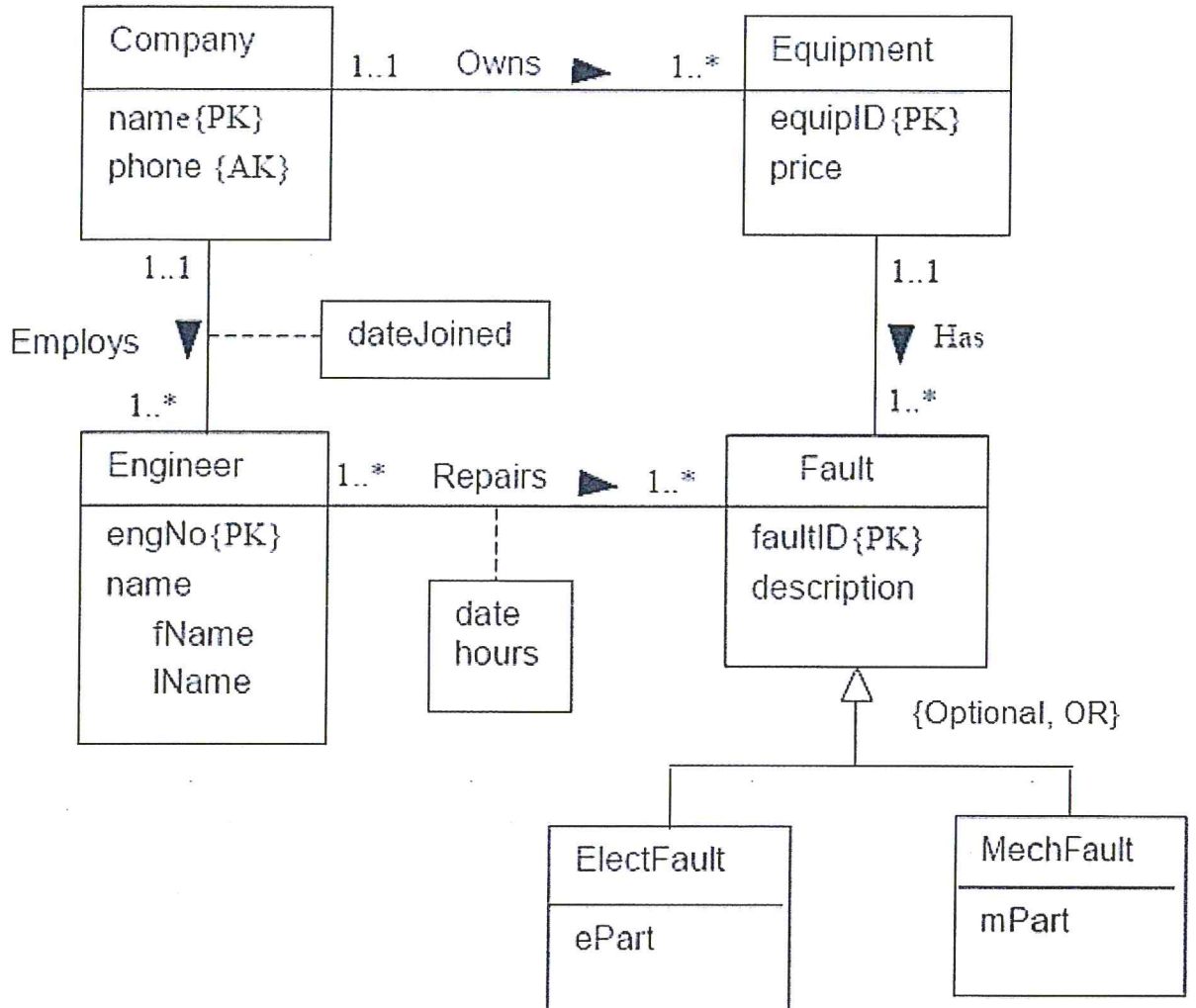
- i. Give a table returned by `SELECT * FROM Book, Publisher` (1 marks)
- ii. Give a table returned by `SELECT * FROM Book CROSS JOIN Publisher` (1 marks)

- iii. Give a table returned by `SELECT * FROM Book NATURAL JOIN Publisher` (1 marks)
- iv. Give a table returned by `SELECT * FROM Book INNER JOIN Publisher USING(ISBN)` (1 marks)
- v. Rewrite the previous `INNER JOIN` query with `ON < condition >` instead of `USING(ISBN)`. (2 marks)
- vi. What are `FULL OUTER JOIN`, `LEFT OUTER JOIN` and `RIGHT OUTER JOIN`? Give an example of the three kinds of outer joins on two tables both of which contain dangles. (2 marks)
- vii. What does it mean for two relations to be union-compatible? (2 marks)

SECTION B
ATTEMPT ANY TWO QUESTIONS IN THIS SECTION

QUESTION 2

- a) Provide a set of relational tables for the high-level data model shown below. Identify primary, alternate, and foreign keys in the tables. (8 Marks)



- b) Consider the following schema (the data type of each attribute is given following the attribute names and the primary keys are underlined):
 Suppliers (sid: integer, sname: string, address: string) Parts (pid: integer, pname: string, color: string)
 Catalog (sid: integer, pid: integer, cost: real)

The Catalog relation lists the prices charged for parts by Suppliers. Write the following queries in SQL that:

- i. List the pnames of parts for which there is some supplier. (4 Marks)
- ii. Find the sids of suppliers who supply a red part or a green part. (4 Marks)
- iii. Find the sids of suppliers who charge more for some part than the average cost of that part (averaged over all the suppliers who supply that part). (4 Marks)

QUESTION 3

Consider the relation Articles (ID, title, journal, issue, year, startpage, endpage, TR-ID) and the listed six queries on the below:

ID	title	journal	issue	year	startpage	endpage	TR-ID
42	Cuckoo Hashing	JAlg	51	2004	121	133	87
33	Deterministic Dictionaries	JAlg	41	2001	69	85	62
33	Deterministic Dictionaries	JAlg	41	2001	69	85	56
39	Dictionaries in less space	SICOMP	31	2001	111	133	47
57	P vs NP resolved	JACM	51	2008	1	3	99
77	What Gödel missed	SICOMP	51	2008	1	5	98
78	What Gödel missed	Nature	2222	2008	22	22	98

1. SELECT title FROM Articles WHERE year=2005;
 2. SELECT title FROM Articles WHERE endpage=100;
 3. SELECT title FROM Articles WHERE year>1995 AND year<2000;
 4. SELECT title FROM Articles WHERE journal='JACM' AND issue=55;
 5. SELECT title FROM Articles WHERE issue=55 AND journal='JACM';
 6. SELECT title FROM Articles WHERE endpage-startpage>50;
- a) Indicate which of the above queries would likely be faster (based on the knowledge you have from the course), if all of the following indexes were created. (8 Marks)

```
CREATE INDEX Idx1 ON Articles(year,startpage);
CREATE INDEX Idx2 ON Articles(startpage,endpage);
CREATE INDEX Idx3 ON Articles(journal,issue,year);
```

- (b) Discuss the "ACID" properties of transactions. Give examples to illustrate your answer. (12 marks)

QUESTION 4

- a) You are designing a database for KW Humane Society. The result is the following set of relations where the type of each relations attribute is given following the attribute (e.g., ID: integer):

Animals(ID: integer, Name: string, PrevOwner: string, DateAdmitted: date, Type: string)
Adopter(SIN: integer, Name: string, Address: string, OtherAnimals: integer)
Adoption(AnimalID: integer, SIN: integer, AdoptDate: date, chipNo: integer)

where

- i. The primary keys are underlined.

- ii. Animals stores information about the animals currently at the Humane Society. Each is given an ID, and their names together with the SIN of their previous owners (attribute PrevOwner), and their date of admission is recorded. Type refers to the type of animal (dog, cat, etc).
- iii. Adopter is the relation that holds information about animal adopters. The attributes are self-descriptive, except OtherAnimals which records the number of other animals that the adopter currently has at home.
- iv. AnimalID in Adoption refers to the ID of Animals. Similarly, SIN in Adoption refers to the SIN of Adopter. Attribute chipNo stores the number on the microchip that is implanted on the animal for tracking. Owner in Animals refers to the SIN of Adopter (in this case the previous adopter).

Formulate the following queries in SQL; each one is worth 2 points:

- i. Retrieve the total number of dogs that were brought to the Humane Society on 18 April 2000. (2 Marks)
 - ii. List the name of the adopter who has adopted every type of animal. (2 Marks)
 - iii. For each animal type, list the animal type and total number of adoptions on 14 June 1999. (2 Marks)
 - iv. List the types of animals who have not had any adoptions. (2 Marks)
 - v. For each adopter who has made at least two adoptions, list their names and addresses. (2 Marks)
- b) Suppose that the Authoring relation is created as follows:

```
CREATE TABLE Authoring(articleID INT REFERENCES Article(ID) ON DELETE SET NULL,
authorID INT REFERENCES Author(ID) ON DELETE CASCADE)
```

Indicate which of the following statements are true, and which are not. Use the answer sheet of the exam for your answer.

- 1. If we try to delete a tuple from Authoring, the tuple is not deleted. Instead, articleID is set to NULL. (1 Mark)
 - 2. If we delete a tuple from Authoring, any tuples in Author referred to by this tuple are also deleted. (1 Mark)
 - 3. If we delete a tuple from Article, some attributes of Authoring may have their values set to NULL. (1 Mark)
 - 4. If we try to insert a tuple into Author, with an ID that is not referred to in Authoring, the operation is rejected. (1 Mark)
 - 5. If we try to insert a tuple into Authoring, with an ID that does not exist in Author, the operation is rejected. (1 Mark)
- c) Write CHECK constraints for Articles of Problem 2 that ensure the following:
- 1. Values of the journal attribute does not start with 'Journal'. (2 Marks)
 - 2. The value of the endpage attribute is never smaller than that of startpage. (2 Marks)

3. The value of year is given in full (e.g. 1999 is not abbreviated as 99). You may assume that year is of type integer, and that there are no articles more than 200 years old. (1 Marks)

QUESTION 5

- a) The table shown below stores details of students and the overall grade each student obtained in different modules. The Primary Key is (StudentID, ModuleID).

Results

<u>StudentID</u>	StudentName	<u>ModuleID</u>	ModuleName	Grade
S001	Smith	M01	Java	A
S001	Smith	M02	Databases	B
S002	Ford	M01	Java	B

- (i) Which Normal Form does the above table violate and why? (3 marks)
- (ii) Give an example of an update anomaly and an example of a delete anomaly that may occur if the table is left un-normalised. Explain the problems that are caused. (4 marks)
- (iii) Show how you would normalise the table. (5 marks)

With reference to a sample relation of your own choosing, explain and discuss the following relational model terminology, including its function and any related concepts. A good diagram showing your sample relation is strongly suggested.

- (i) Attribute
- (ii) Domain
- (iii) Degree
- (iv) Cardinality

Each item is equally weighted.