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The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical & Computer Engineering

Study Programme	: Bachelor of Software Engineering
Name of the Examination	: Final Examination
Course Code and Title	: ECI4166/EEI4266 Data modelling and database systems
Academic Year	: 2017/18
Date	: 12th February 2019
Time	: 09:30-12:30 hrs
Duration	: 3 hours

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of Six (6) questions in Seven (7) pages.
   (Section A – 2 Questions and Section B – 4 Questions)
3. **Section A** is **COMPULSORY** and select any **Three (03)** questions from **Section B**
4. Answer for each question should commence from a new page.
5. This is a Closed Book Test (CBT).
6. Answers should be in clear hand writing.
7. Do not use Red colour pen.

SECTION A

Question 1 (Compulsory)

The customer database for the marketing department of a company named "Big Deal?" is based on the following requirements.

- Persons are identified by a combination of their first name, last name, and date of birth. A person can have an arbitrary number of titles (e.g., Prof. Dr. Sunil Perera).
- For the company, "Big Deal?", we record the sector (e.g., IT) and a unique name.
- A person can work for one or more companies. For each relation between a person and a company we record a job title. We allow companies without employees to be recorded in the database.
- Addresses consist of a street, street number, zip code, city, state, and a unique Id. A person can be associated with an arbitrary number of addresses and multiple persons can live at the same address. A company is associated with one or more addresses. No two companies share the same address. Some addresses in the database may not be associated with any company or person.
- Phone contacts consists of a type (e.g., home or work) and are uniquely identified by a combination of area code and number (e.g., 312 and 123456). Each person is associated with at least one phone contact. Each phone belongs to exactly one person.
- Some, but not all phone contacts are associated with an address. We allow multiple phone numbers for the same address.
- An email address consists of a unique address string (e.g., bglavic@iit.edu). Each email address has one owner (a person), but not all persons have an email address. We do not record multiple email addresses per person.

Answer the following questions. State any assumptions made.

a. Create an Entity Relationship Diagram (ERD) for the scenario stated above. (12 marks)

b. Indicate appropriate cardinality and primary keys in your ERD. (8 marks)

Question 2 (Compulsory)

a. In direct file organization, the key value is mapped directly to the storage location. The usual method of direct mapping is by performing some arithmetic manipulation of the key value. This process is called hashing. Discuss advantages and disadvantages of hashing. (5 marks)

b. What are the three different types of schema corresponding to the three levels in the ANSI-SPARC architecture? (3 marks)

c. Consider the following XML document, bookstore.xml

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<Bookstore>
        <book category="COOKING">
                <title lang="en">Everyday Italian</title>
                <author> Paulo Coelho </author>
                <year> 2005 </year>
                <price> 500 </price>
        </book>
        <book category="COOKING">
                <title lang="en">HarryPotter</title>
                < author> J.K Rowling </author>
                <year> 2005 </year>
                <price> 290 </price>
        </book>
</Bookstore>
```

i. Write a FLWOR expression that returns the book title (title element) in bookstore.xml. (4 marks)

ii. Write a FLWOR expression that returns all the book titles, author, price, year where the price is higher than 300/-. (4 marks)

iii. Write a FLWOR expression that returns all the book titles in the order of titles, author, year where the price is higher than 200/-. (4 marks)

Section B

SELECT ANY THREE (03)

Question 3

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

Results

Table I

StudentID	StudentName	ModuleID	ModuleName	Grade
S001	Smith	M01	Java	A
S001	Smith	M02	Databases	B
S002	Ford	M01	Java	B

i. State in which Normal Form Table I violates and explain why? (2 marks)

ii. Give an example of an update anomaly and an example of a delete anomaly that may occur if the Table I is left un-normalized. Explain the problems that are caused. (3 marks)

iii. Show the steps to normalize Table I. (4 marks)

b. An important concept in the theory of relational databases is that of a functional dependency.
   i. Explain what is meant by a functional dependency and give an example. (1 marks)
   ii. Identify two functional dependencies in Table II (A, B and C are the attributes):

Table II

A	B	C
a1	b1	c1
a1	b1	c3
a1	b2	c1

(3 marks)

c. A company uses Table III to record details of staff. Each staff has up to three qualifications:

Table III

StaffID	StaffName	Qualifications
S01	Ibanga	BSc, MSc, PhD
S02	Kumar	BSc, Msc
S03	Grant	BSc, PhD

   i. Explain why Table III is not in the "First Normal Form" (1NF). (1 mark)
   ii. Show how Table III can be transformed into 1st NF. Give two possible solutions. (6 marks)

Question 4

Refer to the Table IV and Table V for the following questions.

Table IV

TRANSACTIONID	ACCOUNT_ID	TRANSACTION_DATE	AMOUNT
7659897	93008	12/4/2017	3.67
7659898	93008	12/4/2017	12.99
7743433	93008	13/4/2017	-7.99
7935320	331449	13/4/2017	-14.76
8756571	93008	13/4/2017	-5.99

Table V

ACCOUNT_ID	SORT_CODE	ACCOUNT_TYPE	BALANCE
93008	30-54-87	Direct Debit	362.74
331449	31-12-54	Credit	320.26
57746	30-54-87	On-Line Saver	1295.60
16227	12-32-18	Direct Debit	-550.93

a) List the results of running both the following queries (Query A and Query B) and then describe in a few sentences how these results are produced. (5 marks)

Query A:

```
SELECT COUNT(*), account_type
FROM accounts
WHERE balance < 4000
GROUP BY account_type
HAVING COUNT(*) > 1;
```

Query B:

```
SELECT SUM(AMOUNT), t.account_id, transaction_date
FROM transactions t
WHERE t.account_id IN (SELECT a.account_id
FROM accounts a
WHERE account_type <> 'On-Line Saver')
GROUP BY t.account_id, transaction_date
ORDER BY SUM(amount) ASC;
```

b) Write an SQL query that produces the same output as query B using INNER JOIN operator.

(5 marks)

c) Explain the differences between LEFT and RIGHT OUTER JOIN and an INNER JOIN. Illustrate your answer by showing how replacing an INNER JOIN operator with either a LEFT or RIGHT OUTER JOIN operator can affect the output of your answer in part b).

Hint: You must choose between either a RIGHT or LEFT OUTER JOIN to illustrate the difference in output produced compared with using an INNER JOIN. (5 marks)

d) Write an SQL UPDATE statement that updates the running total of the balance for account_ID 93008 for transactions made on this account on 13-APR-2017. Following this update the new balance for this account should be 348.76. (5 marks)

Question 5

Table VI: Worker

Worker_ID	First_Name	Last_Name	Salary	Joining	Department
001	Monika	Peter	100000	2014-02-20 09:00:00	HR
002	Nishantha	Sunil	80000	2014-06-11 09:00:00	Admin
003	Vishal	Perera	300000	2014-02-20 09:00:00	HR
004	Amitabh	Bachan	500000	2014-02-20 09:00:00	Admin
005	Vivek	Bhati	500000	2014-06-11 09:00:00	Admin
006	Vipul	Nalanda	200000	2014-06-11 09:00:00	Account
007	Satish	Kumar	75000	2014-01-20 09:00:00	Account
008	Geetika	Chauhan	90000	2014-04-11 09:00:00	Admin

Table VII: Bonus

Worker_Ref_ID	Bonus_Date	Bonus_Amount
1	2016-02-20 00:00:00	5000
2	2016-06-11 00:00:00	3000
3	2016-02-20 00:00:00	4000
1	2016-02-20 00:00:00	4500
2	2016-06-11 00:00:00	3500

Table VIII:Title

Worker_Ref_ID	Worker_Title	Affected_From
1	Manager	2016-02-20 00:00:00
2	Executive	2016-06-11 00:00:00
8	Executive	2016-06-11 00:00:00
5	Manager	2016-06-11 00:00:00
4	Asst. Manager	2016-06-11 00:00:00
7	Executive	2016-06-11 00:00:00
6	Lead	2016-06-11 00:00:00
3	Lead	2016-06-11 00:00:00

a. Write an SQL query to fetch unique values of Department from Worker Table VI. (2 marks)

b. Write an SQL query to print first three characters of FIRST_NAME from Worker Table VI. (3 marks)

c. Write an SQL query to find the position of the alphabet ('A') in the first name column 'Amitabh' From Worker Table VI. (3 marks)

d. Write an SQL Query to fetch worker's names (full name) with Salaries >= 50000 And <= 100000. (4 marks)

e. Write an SQL Query to fetch the no. of workers for each department in the descending order. (4 marks)

f. Write an SQL Query to print details of the workers who are also Managers. (4 marks)

Question 6

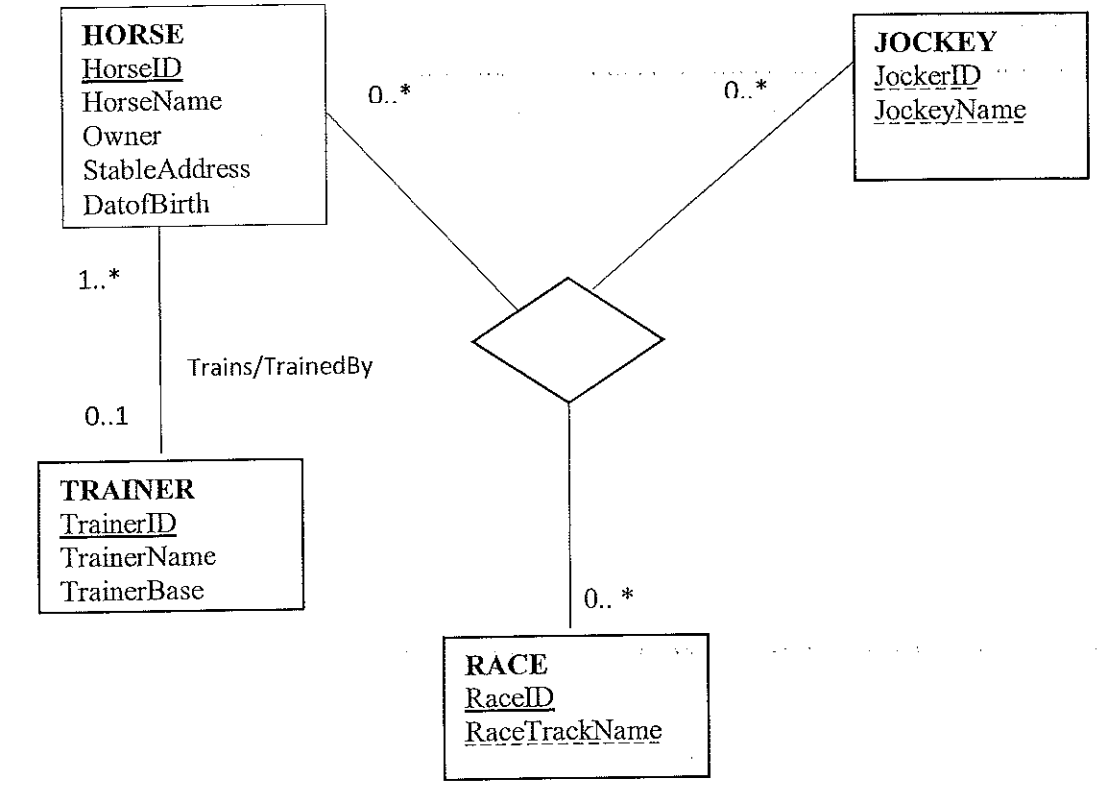

Figure 1: ER Model (UML Class diagram notation)

a. Explain using examples from ER model from Figure 1, the difference between a ternary relationship and a binary relationship. (4 marks)
b. State why many to many relationships need to be resolved into one to many relationships in an ER model. (5 marks)
c. Explain how you would modify the ER model given in Figure 1 in order to resolve many to many relationships. (6 marks)
d. Explain how you would translate your modified ER model (in part c) as a set of Tables, giving table names, column names and an indication of primary and foreign keys. (5 marks)