RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Information and Communication Technology

First Year - Semester II Examination – November / December 2016

ICT 1407 – DATABASE SYSTEMS

Time: Three (03) hours

Instructions

Answer All Five (05) Questions.

Paper contains six (06) pages.

1. Provide short answers to each of the following.

    a) What is a data model? Give 2 examples. (3 marks)

    b) Discuss the disadvantages of traditional file processing systems over database systems. (2 marks)

    c) Explain the purpose of defining a primary key for a relation? (2 marks)

    d) Consider the following relation. (3 marks)

student_id	name	age	email
1001	Rakesh	23	rakesh@ac
1002	Varuna	21	varun@ac
1003	Mathish	21	Mathi@ck
1005	Varuna	20	varunK@ac
1006	Surani	22	surani@ck

Select suitable attribute(s) for following based on the instance given above. Clearly indicate how you choose them.

    i.   Super key
    ii. Candidate key
    iii. Primary key

[10 marks]

2. Answer the following questions based on Entity Relationship diagrams.

    a)   Explain these terms with examples.   (5 marks)

          i.   Weak entity

          ii.   Total participation

    b)   Read the following description of data requirements of a certain Academic and research organization.   (20 marks)

It is concerned with modeling of a database that contains information on researchers, academic institutions, and collaborations among researchers. Researchers publish the research papers. A researcher can either be employed as a professor or a lab assistant. There are three kinds of professors: Assistant, associate, and full professors. Professors receive money as a grant for their research projects while lab assistants are paid for the extra hours they are working.

The following data and requirements should be stored:

- For each researcher, his/her name, unique Id number and year of birth.
- For each institution, institution id, its name, country, and year of establishment.
- For each institution, the names of its schools (e.g. School of Law, School of Business, School of Computer Science, …). A school belongs to exactly one institution.
- An employment history of employees, including information on all employments. (start and end date, position, and the school).
- Information about research papers, i.e. researchers who have published the research papers and the titles of research papers.
- Information on researchers' highest degree (BSc, MSc, PhD, …), including who was the main supervisor, and at what school.
- For each professor, information on what research projects (title, start date, and end date) he/she is involved in, and the total amount of grant money for which he/she was the main applicant.

Draw an ER/EER diagram for the data set described above. Make sure to indicate all cardinality constraints specified above.

The ER/EER diagram should not contain redundant entity sets, relationships, or attributes. If you need to make any assumptions, include them in your answer.

[25 marks]

3. Following questions are based on mapping and normalization

a) A part of bank data base is illustrated in the ER diagram given below. Map the ER diagram into the corresponding relational model. (18 marks)
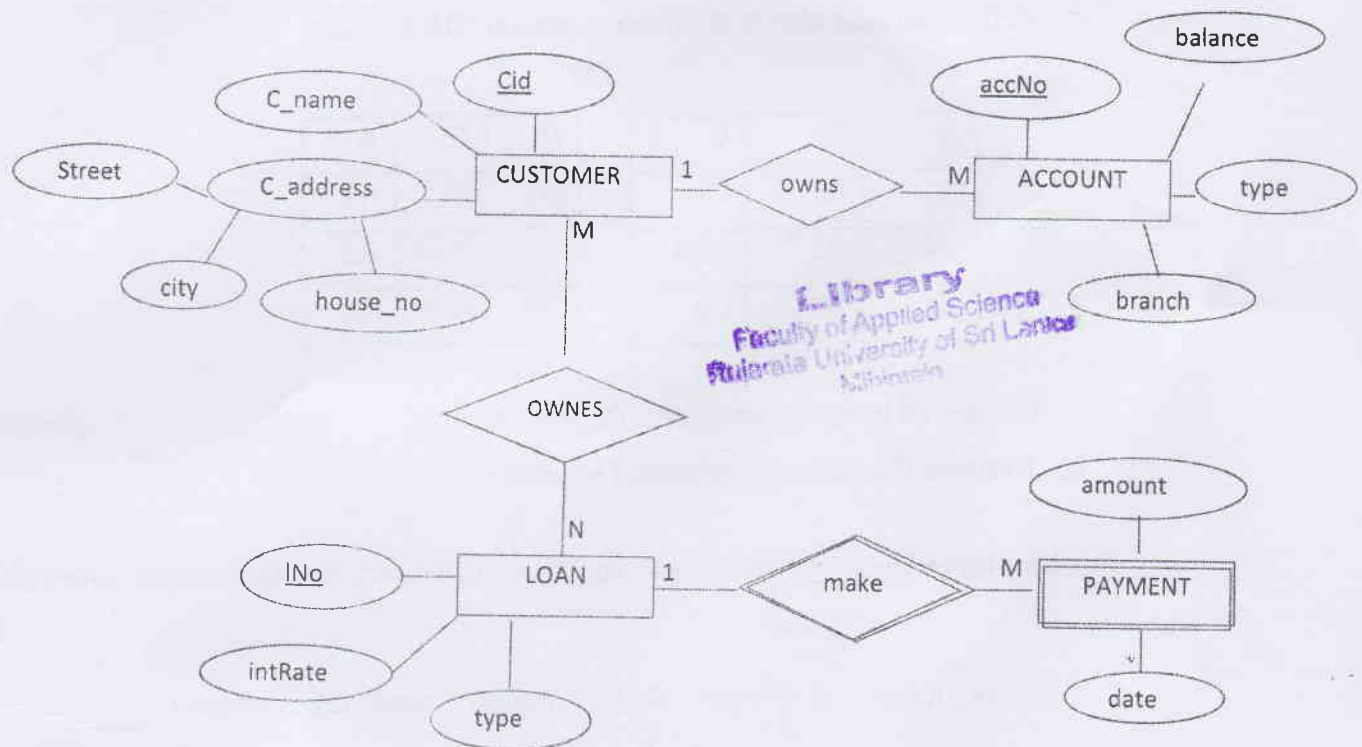
b) What is the need for normalization? (2 marks)

c) Give two main problems that arise in a database due to data redundancy? (2 marks)

d) Consider the following relation:

CAR_SALE (car_no,date_sold,salesmanID,commission,discount_amount)

Assume that car may be sold by multiple salesman hence car_no and salesmanID together make a primary key and all values are atomic in the relation.

Additional dependencies are;

Date_sold ⟶ discount_amount

$$salesmanID \longrightarrow commission$$

    i. Based on the given information, explain whether the relation is in 2NF or 3NF. Justify your answer. (4 marks)

    ii. Reduce the relation into a set of well normalized relations. (4 marks)

[30 marks]

4.   a) Consider following two relations R and S. Given that **A** is the primary key of **R**, **D** is the primary key of **S** and there is a referential Integrity between **R** and **S** via attribute **A**. And also both relations contain NULL values.

A	**B**	**C**
A1	B1	C1
Null	B2	Null
A2	B1	C2

R

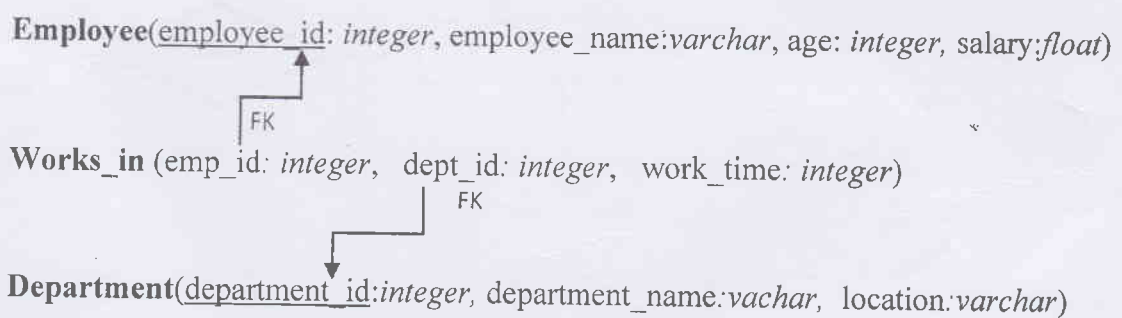| **D**	**E**	**A**
D1	E1	A1
D2	Null	A2
D3	Null	A3

S

Discuss all integrity constraints that are violated. (4 marks)

   b) Examine the following relational schema.

Employee(employee_id: *integer*, employee_name:*varchar*, age: *integer*, salary:*float*)

     FK

Works_in (emp_id: *integer*, dept_id: *integer*, work_time: *integer*)

            FK

Department(department_id:*integer*, department_name:*vachar*, location:*varchar*)

Write appropriate SQL Statements for each following. (10 Marks)

       I. Define the given foreign keys for above relations.

       II. List the employees who have a salary over than 20,000.00.

       III. Find all the employee names who are working in department id=3.

       IV. Give a 10,000.00 bonus to each employee's salary.

       V. Delete the record ('1002','Silva',32, 35000) from **Employee**.

           Explain what happens when this statement is executed.

c) Consider the above schema in part b) and write relational algebraic queries to perform each of these. (6 marks)

    I.   Select all the employees whose age is greater than 30.

    II.   Select all the employee names whose age is 45 and salary is greater than 30,000.

    III. Find all the employee names who are working for the department id=3.

[20 marks]

5.   a)   State whether the following statements are true or false. Justify your answers (6 marks)

    i. Every candidate key is a super key

    ii. Every super key is a primary key

    iii. For a well designed database, redundant data must be removed.

b)   Write short notes on following. (9 marks)

    i.   Storage Management of database systems.

    ii.   Three-tier architecture of database

    iii. Insertion anomaly

[15 marks]

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