UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 4 Examination in Engineering: February 2020

Module Number: EE4202 **Module Name: Database Systems**

[Three Hours]

[Answer **all questions**, each question carries 10 marks.
Attach Page 7(Figure Q2) to your answer script]

(Q1)

(a) (i) List 2 types of data models used in Database Systems and provide 2 examples for each of them?

[1.5 mark]

(ii) List down the types of schemas in 3-schema architecture?

[1.5 mark]

(iii) Explain what is physical data independence?

[1 mark]

(iv) What aspects of a transaction are maintained by logging and recovery manager and concurrency control manager of a database management system?

[1 mark]

(b) A relation EMPLOYEE('Empl_ID', 'Dept_ID', 'Designation', 'Area') is defined in a schema identified by sch1. 'Empl_ID' is a 5-letter string and 'Dept_ID' is a 4-letter string. Both 'Empl_ID' and 'Dept_ID' do not allow NULL values to be entered. If the user does not enter a value for Designation; it should be set as "Lecturer". NULL values are allowed in attribute Area.

(i) What is meant by DDL in database systems. Specify the keywords used in SQL for defining a relational schema and to change an existing relational schema?

[0.5 mark]

(ii) Write the SQL statements to create the relation EMPLOYEE?

[1.5 mark]

(iii) Assume that there is a relation known as HEAD in sch1. Now the Dept_ID attribute of EMPLOYEE table needs to add a referential integrity constraint with attribute Dept_ID of HEAD table. Upon Update and deletion operation of

entries in Dept_ID of HEAD table; entries in EMPLOYEE table must be cascaded and set to null respectively. Write SQL statements for doing this task?

[1.5 mark]

(iv) Write SQL statements to change the relation EMPLOYEE such that attribute Area is renamed to Specialization with all previous constraints. Further, Data type of Designation is changed to enter a string up to 25 characters. If the user does not specify a value for Designation; then designation attribute must be set to "desig"?

[1.5 mark]

(Q2)

(a) Consider the partially completed Entity-Relationship (ER) diagram given in Figure Q2 for a bank database.

(i) Following requirements are specified for the ER diagram.

- It is given that every customer does not necessarily have to maintain an account nor loan. But, every account or loan must have at least one customer.
- A customer is restricted for obtaining only 3 loans and limited for maintaining 5 accounts. An account of a bank branch can be maintained/shared up to 2 customers whereas only one customer can obtain a loan from a particular branch of a bank.
- Any given account or loan must belong to a particular branch.
- All bank branches have accounts; but some bank branches may not issue loans. For banks which issue loans; the total number of loans that can be issued by a bank is restricted to 2000. There is no upper limit on the number of accounts that can be held by a branch.
- Attribute Cutomer_ID is unique across different banks.
- Zip-code is a globally unique number for any city in the world.

[1] Based on these requirements, complete the ER diagram given in Figure Q2. Use the same notation given in ER diagram to show relationship constraints.

[2 marks]

[2] Redraw the ER diagram using (participation constraint, maximum cardinality ratio) notation for relationships. No need to draw the attributes?

[2 marks]

(ii) Answer the following questions based on the ER diagram completed in part (a)(i).

[1] What is the data model which ER diagrams are drawn for?

[1.0 mark]

[2] List down the weak entity types and their corresponding partial keys and identifying relationships?

[1.0 mark]

[3] What is the cardinality ratio in BANK_BRANCH and LOAN in ISSUES relationship?

[1.0 mark]

[4] What kind of participation constraint does the entity ACCOUNT is having in HAS relationship with BANK_BRANCH?

[1.0 mark]

(b) (i) [1] What constraints do the partial key(s) and the identifying relationship(s) specify in ER diagram you completed in Figure Q2?

[1.0 mark]

[2] State and briefly explain the three types of meaning of NULL value of an attribute?

[1.0 mark]

(Q3)

(a) (i) What is meant by aliasing in SQL queries and what is the keyword used for substring pattern matching?

[1 mark]

(ii) Following relations are defined inside the relational schema sch2.

HEAD('Dept_ID', 'Dept_Head')

EMPLOYEE('Empl_ID', 'Dept_ID', 'Designation', 'Age')

PROJECT('Empl_ID', 'Project')

DEPENDENT('Empl_ID', 'Depe_name', 'Gender')

(A) Write SQL queries for following scenarios and then convert them to relational algebraic expressions for each of the following?

[1] Retrieve the age after 5 years as AGE5 whose age is greater than age of employee with Empl_ID equal to EE001. Store the retrieval result in a new relation known as viel.

[2 marks]

[2] Retrieve the Designation, no. of Employees working under a designation and average age of employees for that designation.

[2 marks]

(B) Write the below query in SQL

Query: Retrieve the Employee ID, Designation of Employees who are doing both Project "Prj_1" and have "Sajitha" as the department head (Dept_Head).

using;

[1] Natural join only without set operations, inner join, views.

[2] Inner join and set operations only without views, natural join.

[3] Natural join and set operations only without views, inner join.

[4] Inner join, set operations, views only without natural join.

[5] Natural join, set operations, views only without inner join.

[1.0 x 5 marks]

(Q4)

(a)

(i) State the CAP theorem in distribution database model and briefly explain it using an example?

[1 mark]

(ii) What is meant by eventual consistency in NoSQL databases?

[1 mark]

(iii) State and briefly introduce 4 types of version stamps used in concurrency control of transactions in NoSQL databases?

[2 marks]

(iv) State what is map reduction and pipelining?

[1 mark]

(v) List 4 types of data models in NoSQL databases providing an example of a database management system for each of them?

[2 marks]

(b) Write all the Cassandra Query Language (CQL) statements required for doing the following task.

Create a column family store for storing shopping-cart data. The data should be replicated to 5 nodes. In order for an update operation to succeed, the majority of the replicated nodes must agree between each other. The main key must be an integer used as the shopping cart_ID. The value part is a generic aggregate consisting of key-value pairs storing shopping cart information. Insert two rows of data and write a query to retrieve the second row?

[3 marks]

(Q5)

(a) Consider the relation EMPLOYEE (Empl_ID', 'Dept_ID', 'Designation', 'Salary') defined in a schema sch1. Write SQL statements for the following?

(i) There is a requirement of a constraint in EMPLOYEE table such that salary of all employees who work under department EIE must have salary greater than all other department salaries.

[1.5 mark]

(ii) There is a requirement to check the salary value before the update of a salary such that if the user entered new salary is greater than 7500 when compared with the existing salary; the update operation must fail and an error message should be displayed to the user.

[1.5 mark]

(b)

(i) Specify 4 features of a transaction that should exist in a relational database.

[1 mark]

(ii) Briefly explain the keywords used in SQL for relational databases to maintain above mentioned features of a transaction?

[2 marks]

(iii) State the two types of major access control methods used in database systems and list two features for each of them?

[2 marks]

(c) Write SQL queries to implement the following scenario.

Root gives insert privilege on any table in schema sch1 to rol1 with the ability to propagate object privileges. Then, root gives select privilege on EMPLOYEE table to user1. Then root further assigns rol1 to user1 with ability to propagate it and assign rol1 to user3 without the ability to propagate it. Then he assigns rol2 to user2 and user4. Finally, he logs out.

[2 marks]

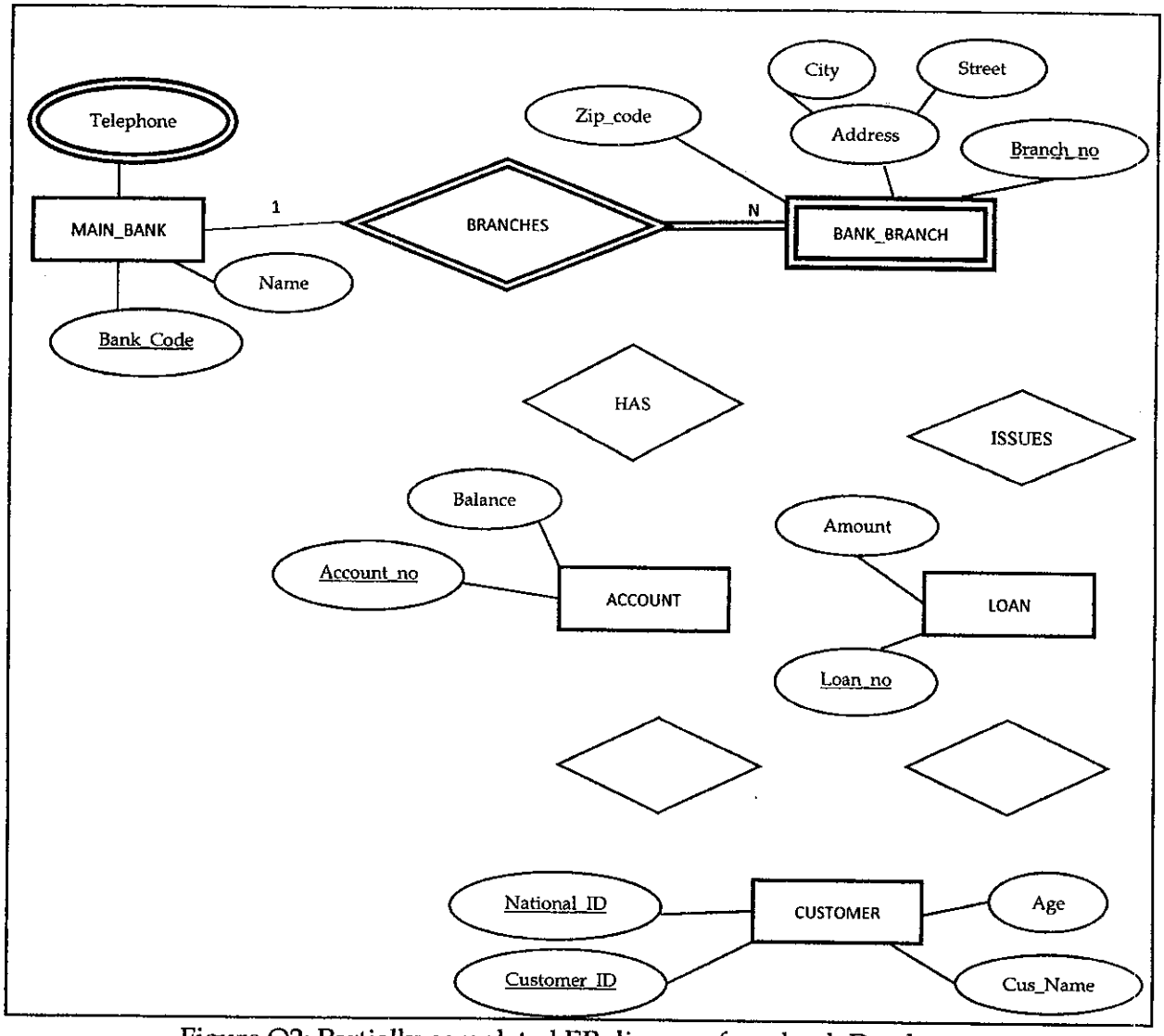

Figure Q2: Partially completed ER diagram for a bank Database