UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 5 Examination in Engineering: October 2019

Module Number: EE5203 **Module Name: Data Management Systems**

[Three Hours]

[Answer **all questions**, each question carries 10 marks]

Q1 a) Describe the difference of weak entity and strong entity.

[1 Mark]

b) What are the rules of setting a primary key of a database table?

[1 Mark]

c) Assume you are hired to develop a database management system for tracking the operations of rail yard system. Following are the daily operations which are functioned in rail yard.

Rail cars (trains) come to the yard with containing items. Then items are removed from rail car and stored in the inventory which is situated inside the rail yard. Relationship with items and rail car is over after storing items in yard inventory. Then transloading operations are started. Transloading means items which are stored in inventory, are taken out to the outside world. This operation is done through Trucks. Trucks come to the yard inventory and load the items based on based on order. Order is related with items which are stored in yard inventory. One order can contain one or more multiple Items. Orders are delivered to the relevant company (destination place) from yard (inventory) via trucks. Trucks are driven by the Drivers. (one truck can be driven by multiple drivers or one driver can be assigned many trucks. Simply no driver is desired for particular truck).

Note:
- A rail car contains multiple items and trucks transfer multiple orders to multiple company (multiple order destination).
- Order may contain one item or multiple items.
- In this case, item means large box which contains particular materials and you don't want to take care of those. Only consider item.

i) Draw the ER diagram based on the above case study.
ii) Draw the table structure according to the ER with the key constraints.

[8 Marks]

Q2 a) Write following queries in relational algebra expressions.
i) select * from Employee where salary > 30000.
ii) select movieTitle from StarsIn, MovieStar where starName = 'jim' AND birthyear = 1985.
iii) select e.number , e.address from Employee e, Department d where d.name = 'Research'.

[5 Marks]

b) Answer the following questions based on the case study and table structure given.

Assume that you have a database system for handling and managing Employees of a software company. Employees are categorized based on their role and they are working in different departments.

Employee (emp_id, first_name, last_name, salary, role, dept_id)
Department (dept_id, name, location)

Write down SQL queries for following scenarios.

i. List the first name of all employees who works in the department having dept_id=5.

ii. List all the details of employees who work in the department with name "Tech".

iii. Total number of employees working in the "Admin" Department.

iv. List down dept_id and employee count of the departments which have more than 3 employees in it.

Note: No need to show the department name.

v. List down the department name along with the total salary of all the employees in that department?

[5 Marks]

Q3 a) What are the advantages and disadvantages of using indexing in database.

[2 Marks]

b) What is the difference between a dense index and a sparse index?

[2 Marks]

c) Briefly explain primary index and secondary index.

[2 Marks]

d) Suppose that you are given following details regarding mostly used table of the data base schema. You have to implement index file to optimize DB queries related to Employee table. Assume that you implement primary index in this scenario. Find the average Number of Block access after indexing.

Number of records = 30000
Block size = 1024 bytes
Record size = 100 bytes
Key of index size = 6 bytes
Pointer of index size = 9 bytes

[4 Marks]

Q4 a) What are the characteristics of a database table in First Normal Form (1NF)?

[1 Marks]

b) Use an example to explain **Insertion**, **Update** and **Deletion** anomalies available in a database which is not normalized.

[3 Marks]

c) A table in first normal form is used to store student course information in a university as shown in Table Q4 c). This table known as the student_courses is created using the following schema definition.
Student_courses (student_ID, first_name, age, batch_no, reg_year, course_ID, course_name, total_hours)

Table Q4 c)

student_ID	first_name	age	batch_no	reg_year	course_ID	course_name	total_hours
EG_2120	Pahan	23	17	2015	EE-5304	Database Systems	42
EG_2120	Pahan	23	17	2015	EE-5104	Sensors & Transducers	14
EG_2130	Mihiri	22	18	2016	EE-5304	Database Systems	42
EG_2130	Mihiri	22	18	2016	EE-5104	Sensors & Transducers	14

It is known that a student can follow/register for multiple courses. Further, a given course can be offered to many students.

i) Write down the partial dependencies which exist in the above table?

[1 Marks]

ii) Convert this table in to 2nd Normal Form with data inserted into tables. Show the primary key in each table using usual notation?

[2 Marks]

iii) Write down the transitive dependencies that exist in the 2NF table?

[1 Mark]

iv) Convert the 2nd Normal form table obtained in Q4 c) (ii) above in to 3rd Normal form with data inserted into tables. Show the primary key in each table using usual notation?

[2 Marks]

Q5 a) Define the following unary operations in the context of database relational algebra.

i) Select

ii) Project

iii) Rename

[3 Marks]

b) You are given the following Relations.

ENGINEER

FirstName	LastName
Somasiri	Godage
Dumindu	Buddhika
Jim	Manson
Nimal	Kumara
Nmantha	Alwis
Nishada	Liyanage
Somasiri	Godage

MANAGER

FirstName	LastName
Somasiri	Godage
Namal	Perera
Priyan	Gamage
Dumindu	Buddhika

What are the outputs after applying following set operations?

i) ENGINEER $\cup$ MANAGER

ii) ENGINEER $\cap$ MANAGER

iii) ENGINEER – MANAGER

iv) MANAGER – ENGINEER

[2 Marks]

c) Write short notes on the following topics in the context of relational databases.

i) INNER JOIN

ii) UNION

iii) GRANT

iv) REVOKE

v) DISTINCT

[5 Marks]