

University of Ruhuna- Faculty of Technology
Bachelor of Information & Communication Technology Honours Degree
Level 1 (Semester II) Examination, November/December 2022
Academic year 2020/2021

Course Unit: ICT1213 Database Management Systems (Written)

Repeat Examination

Duration: 2 hours



IMPORTANT INSTRUCTIONS:

1. The medium of this examination is English.
2. This is a closed book examination.
3. This question paper contains **five (05) pages** including this instruction page.
4. This examination consists of **four (04) questions** that are given equal marks.
5. You must answer **all four (04) questions** in this examination.

01. A Motor Vehicle Administration Branch in Matara district has decided to start a website to maintain their official activities to make an efficient service to its customers. A part of their requirements to design the website is given below.

Any person can own a license from any branch and the system stores that person's unique NIC, name, birthdate, address and postal code with several contact numbers.

Learner-license and Driver-license are the only licenses which are issued by any branch. A license has a unique license number, license class, and an expiry date. A person owns one license and that particular license can have only one owner(person).

Any person who wants to get a driver's license must first take a learner's exam at the any Motor Vehicle Branch in Matara district. If that person fails the attempt, he/she can take the exam again any time after two weeks of the attempted exam date, at any branch. Exam date and the marks should be kept.

If the person passes the exam, he/she can get a learner-license with a unique license number. A learner's license contains a learner code.

The person may take his driver's exam at any branch any time before the learner's license expiry date which is usually set at four months after the license issued date. And issued date is set when a branch issues license. If he/she passes the exam, the branch issues him a driver's license. The person passes or fails the exam according to the exam marks given when taking the exam from a branch.

A driver-license must also record if the driver has completed his/her driver's education, for insurance purposes. Anyway, the same person can take exam at different branches different times and one branch can have many people to get the license.

A branch is completely responsible for issuing a license and also it has unique id, name, city, several contact numbers and postal code. A branch can issue many licenses and but a unique license can only be issued by one branch and while issuing the license, they keep record of the issue date. A branch totally involves in issuing license.

The officers in this system manage the driving tests and issue driver's licenses when they are assigned to any branch. Without a branch, there cannot be any officer. The database needs to keep tracks of officers with their employee id, name including first name and last name, birthdate, designation and age which has been derived from officer's birthdate. There are many officers assigned to a branch and no officer can work for two branches.

- a. Draw an **ER diagram** that captures the above requirements by indicating relevant entities, relationships, and attributes along with key attributes. Specify the cardinality and participation constraints. State any assumptions you have made.

[70 marks]

- b. Map the ER diagram you obtained in part (01)(a) into a set of relations. Specify all primary keys and foreign keys of each relation.

[30 marks]

02.

- a. Consider the following relations for a part of a database that has records of foreign trips of employees in a company:

EMPLOYEE (ESSN, EName, StartYear, DeptNo)

TRIP (TripID, ESSN, FromCity, ToCity, TripDepartureDate, TripReturnDate)

EXPENSE (TripID, AccountNumber, ExpenseAmount)

Express the following queries in **Relational Algebra** and **Tuple Calculus**.

[50 marks]

- i. Find the ESSNs of employees who took trips to 'Singapore'.
- ii. Find all the details of trips that exceeded Rs.20,0000.
- iii. Retrieve the trip expenses (TripID and ExpenseAmount) incurred by the employee with ESSN = '25634'.

- b. Consider the given table structure for Student record in a 'Student' table:

```
Student {
  SID int;
  Student_name char[22];
  Marks float;
  Department char[10];
};
```

- i. Count the **record size (R)** of 'Student' in bytes.

[16 marks]

- ii. Assume that the file has 500 records and un-spanned organization with block size $B = 512$ bytes. Find the **blocking factor (bfr)** and the **number of blocks (b)** to store entire Student records.

[20 marks]

- iii. Calculate the **unused space** in each block.

[14 marks]

03.

a.

- i. Consider the following two relations:

Relation R

X	Y	Z
X1	Y1	Z1
Null	Y2	Null
X1	Y1	Z1

Relation S

A	X	B
A1	X1	B1
A1	X2	Null

Assume that, one has specified as X is the primary key of R, A is the primary of S. And it specifies a referential integrity between S.X and R.X. By considering above scenario, identify all **integrity constraints** that are violated in above two relations.

[15 marks]

- ii. What do you mean by **union compatibility of relations**? State why 'intersection' of two relations cannot be made if they are not union compatible.

[20 marks]

- iii. Describe the **GRANT statement** and explain how it relates to security. What types of privileges may be granted?

[15 marks]

b.

- i. Describe **three-schema architecture** of the database system.

[30 marks]

- ii. Describe **RAID Level 4** and **Level 5** by specifying two (02) key points for each.

[20 marks]

04.

a.

- i. Describe **three (3) types of anomalies** in database systems.

[15 marks]

- ii. Consider the given relation R with attributes named P, Q, R, S, T, U and V with the functional dependencies as follows:

$PS \rightarrow T$
 $Q \rightarrow R$
 $QT \rightarrow U$
 $PU \rightarrow V$

List the **candidate keys** of relation R.

[10 marks]

b.

- i. Assume that you have the relation R in (04)(a)(ii) as R(PQRSTUV). State a **BCNF lossless-join decomposition** for the given relation R.

[15 marks]

- ii. The following 'Lecturer' relation shows the records of lecturer. What is the normal form of the given 'Lecturer' relation? Justify your answers.

[10 marks]

<u>LecId</u>	<u>LecName</u>	<u>Did</u>	<u>Dname</u>	<u>Payment</u>	<u>Vtype</u>	<u>Vcolor</u>
L01	Namal	D01	Dep IT	10000	Car	Red
		D02	Dep ET	20000		
			Dep BST	30000		

LecId : Lecturer id of the lecturer

LecName : Name of the lecturer

Did : Department id

Dname : Name of the Department

Salary : Payment for working in a particular department

Vtype : Type of the vehicle lecturer is using

Vcolor : Color of the vehicle lecturer using

- iii. Normalize the 'Lecturer' relation in to **Third Normal Form (3NF)**. Show your intermediate steps clearly.

[50 marks]

.....*End*.....