University of Ruhuna - Faculty of Technology

Bachelor of Information & Communication Technology Honours Degree
Level 1 (Semester II) End Semester Examination, November/December 2023
Academic Year 2022/2023

Course Unit: ICT 1213 – Database Management Systems
(Theory)

Duration: 02 Hours

This practical exam paper contains 06 pages including this instruction page.

IMPORTANT INSTRUCTIONS:

1. The medium of this examination is **English**.

2. This is a **Closed Book** examination.

3. This Examination consists of **four (04)** questions that are given equal marks.

4. You must **answer all four (04) questions** in this examination.

1. A student group from the Department of ICT is going to store the details about all the societies and their members of the Faculty of Technology. Part of their requirements to design the system is given below.

   There are many students Societies in the Faculty of Technology. For a given society there's a unique identity, a name, a unique email address, a few contact numbers and a member who manages all the things in the society. When electing a member to manage the society, it records the last date of the appointment for the elected member. Each society has many members who are level 02 to level 04 students and there cannot be any society without members.

   A society may host many events and there are no collaborative events in the faculty. An event has a unique identity, name, budget, and a date. Every event in the faculty is hosted only by a society.

   Students are registered in the societies as members by using a unique identity, name, gender, email address, and a contact number. Members belong to at most one society. Every member has a mentor who is also a member of the same society, and a mentor may have more than one member as mentees. Members must contribute to events and every event must have members who work on the events. There are many members assigned for an event and a member can be assigned for many events as well. The time a member has worked for an event is recorded.

   Members can train Level 01 students as Trainees for the society which they belong to. For a specific trainee, there is only one trainer, and a trainer can train only one trainee as well. Without the trainer the trainee cannot exist in a particular society. A unique id, name, and a contact number are recorded when a trainee is trained by a trainer. When a member is resigning from a society the trainee cannot exist in the system anymore.

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

      [70 marks]

   b. Map the ER diagram you obtained in part (1) (a) into a set of **relations**. Specify all **primary keys** and **foreign keys** of each relation.

      [30 marks]

2.
   a. Write down **two (02)** *differences* between Tuple Relational Calculus and Domain Relational Calculus.

      [10 marks]

   b. By considering the relations given regarding the registration of foreign students in the faculty answer the questions given below.

      STUDENT(sid, sname, snationality, aid)
      ADVISOR(aid, aname, acontact)
      COURSE(cid, cname)
      ENROLLMENT(sid, cid, edate)

STUDENT	ADVISOR
• sid – unique id of the foreign student • sname – name of the foreign student • snationality – nationality of the foreign student • aid – unique id of the advisor of the foreign student	• aid – unique id of the advisor • aname – name of the advisor • acontact – contact no of the advisor
COURSE	ENROLLMENT
• cid – unique id of the course • cname – name of the course	• sid – unique id of the foreign student • cid – unique id of the course • edate – date of enrollment of the student to the course

- Express the following queries in **Relational Algebra.**

  i. List the names of all foreign students who are "*Americans*".

  [05 marks]

  ii. List the names of advisors who are the advisors of "*Indian*" students.

  [10 marks]

  iii. List the names of advisors who have *no students* assigned to them.

  [10 marks]

  iv. List the names of students and their advisor's name of the students who are registered in "*DBMS*" course after "*2023-11-01*".

  [15 marks]

- Express the following queries in **Tuple Relational Calculus.**

  v. List the unique student ids and the enrollment dates of the foreign students for the course named "*AI*".

  [10 marks]

  vi. List the names of foreign students who are *not enrolled* in any course.

  [15 marks]

- Express the following queries in **Domain Relational Calculus.**

  vii. List the names of the foreign students whose advisor name is "*Nimal*".

  [10 marks]

  viii. List the names of foreign students who have *not registered* for the course named "*MIS*".

  [15 marks]

3.

a.

   i. Write down **two (02)** problems associated with "*NULL*" values in a relation.

       [10 marks]

   ii. Write down **one (01)** *advantage* and **one (01)** *disadvantage* of Normalization.

       [10 marks]

   iii. Write down **two (02)** requirements for a relation to be in *Boyce-Codd Normal Form (BCNF)*.

       [10 marks]

b. Answer the following questions by using the "*student*" relation and the details given below.

sNo	name	age	dep	hod	bID	name	bDate
TG025	Silva	25	ICT	Soyza	B001	Java	01-10-2023
					B002	C	05-07-2023
					B003	HTML	01-12-2023
TG002	Perera	23	ET	Kumara	B006	Drawing	02-06-2023
					B002	C	06-10-2023
TG050	Jude	24	BST	Nimal	B010	Pathology	25-08-2023

Relation : student

sNo : Registration number of the student, Primary Key of the relation
name : Name of the student
age : Age of the student
dep : Name of the department that students belong
hod : Name of the head of the department
bID : Unique ID assigned for a book
name : Name of the book
bDate : The borrowed date for a particular book for the student

   i. By indicating the *intermediate steps clearly*, **Normalize** the "student" relation in to **Third Normal Form (3NF)**.

       [40 marks]

   ii. Briefly describe the following concepts by using examples from "*student*" relation or its normalized forms.
       - Partial Dependency
       - Transitive Dependency
       - Modification Anomaly

       [30 marks]

4.

a.

i. List down **four (04)** *characteristics* of a bad database design.

[10 marks]

ii. Briefly describe the concept of "**Integrity**" in the context of a database.

[10 marks]

iii. Write down **two (02)** changes you need to make in your database, currently hosted in a local server, to facilitate its migration to a cloud environment.

[10 marks]

iv. Briefly describe the concept of **RAID Level 5** by using a *suitable diagram*.

[10 marks]

v. Write down **one (01)** *advantage* and **one (01)** *disadvantage* of RAID level 5.

[10 marks]

b. Consider a magnetic disk with the sector size of **2048 bytes**, **1000 tracks** per surface, **100 sectors** per track, **five (05)** double sided platters. Answer the following questions.

i. What is the **capacity** of the disk?

[10 marks]

ii. State weather following block sizes are **valid or invalid**. Give your reasons.
- 2048 B
- 400 KB

[10 marks]

iii. If the disk platters rotate at **15 000 rpm** (revolutions per minute), what is the *maximum rotational delay*?
What is the *average rotational delay*?

[10 marks]

iv. What is the *transfer rate* of the magnetic disk, if **ten (10)** tracks of data can be transferred per revolution?

[10 marks]

v. If **two (02)** blocks perfectly fit in to one sector of the disk, *how many records* of **128 bytes** each long can be stored using this disk?
Assume that no record is allowed to span two blocks and no block can span two tracks.

[10 marks]

------- End of Paper ------

[10 marks]