UNIVERSITY OF COLOMBO, SRI LANKA

UNIVERSITY OF COLOMBO SCHOOL OF COMPUTING

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

Academic Year 2016/2017 – Second Year Examination – Semester II – 2018

SCS2109 – Database II

TWO (2) HOURS

To be completed by the candidate

Examination Index No: .....

Important Instructions to candidates:

1. The medium of instruction and question is **English**.
2. Note that questions appear on both sides of the paper. If a page is not printed, please inform the supervisor immediately.
3. Write your index number on each and every page of the Question paper.
4. **This paper consists of 04 questions in 15 pages.**
5. Answer **ALL** questions. All questions carry equal marks (25 marks).
6. Any electronic device capable of storing and retrieving text including electronic dictionaries and mobile phones are **not allowed**.
7. Non-Programmable Calculators are **allowed**.

For Examiner's use only	
Question No	**Marks**
1	
2	
3	
4	
Total	

Index No: .....

1. (a) Briefly explain the three (3) main goals of database security.

[3 Marks]

(b) Authorization subsystem is responsible for ensuring the security of portions of a database against unauthorized access. It allows users having specific rights to grant rights to other users and subsequently to revoke these rights.
Suppose that the Database Administrator creates five user accounts: A1, A2, A3, A4 and A5. Only A1 has been given the permission to create tables and A1 has created the two relations Student and Department as follows.

Student (SID, Name, Address, Gender, DoB, DeptNo)
Department (Dno, Dname, HoD, Address, Tel)

Write down the SQL statements for the following.

i. A1 grants the modify privileges on Student relation to A2. [2 Marks]

ii. A3 should be able to update only HoD and Tel attributes of the Department relation. [2 Marks]

iii. A1 authorizes A4 to retrieve information from Student relation and propagate this privilege. [2 Marks]

iv. A1 wants to grant limited capabilities to A5. A5 should only be able to retrieve SID, Name and Address attributes of all the students whose department number is 2. [4 Marks]

v. A1 decided to remove only the delete privilege on Student relation from A2. [2 Marks]

i.

ii.

iii.

iv.

v.

(c) Database Administrator has identified that since there are many users in the Database System it is difficult to assign privileges to individual users. Hence he decided to create roles. (Refer to the same two relations created in part 1.b)
Write SQL statements for the following.

i. Create a new role as "ComputerAssistant". [2 Marks]

ii. Grant modify privileges on Student and Department relations to ComputerAssistant. [2 Marks]

iii. Assign ComputerAssistant role to A2 and A3. [2 Marks]

iv. Remove Update capability on HoD attribute of Department relation from ComputerAssistant. [2 Marks]

v. Remove the role ComputerAssistant from the database. [2 Marks]

i.

ii.

iii.

iv.

v.

2. (a) Briefly explain the four (4) properties of a transaction.

[4 Marks]

(b) Consider the following schedule created using five transactions. Is this schedule conflict-serializable? If it is, give an equivalent serial schedule. If not, explain why? Label the edges with the data that causes the conflict.

S1: R2(X), R1(Y), R1(Z), R5(V), R5(W), W5(W), R2(Y), W2(Y), W3(Z), R1(V), R4(Y), W4(Y), R4(Z), W4(Z), R1(U), W1(U)

Note: R1(X) denotes Transaction 1 Read X value.
W2(X) denotes Transaction 2 Write X value.

[7 Marks]

(c) Consider the following two transactions T1 and T2 executed concurrently on the Employee(emp_ID, Name, Dept) relation.

T1	T2
INSERT INTO Employee VALUES (1,'Nimal',5); INSERT INTO Employee VALUES (2,'Saman',8);	
	INSERT INTO Employee VALUES (3,'Gamini',4); INSERT INTO Employee VALUES (4,'Sanduni',3); DELETE FROM Employee WHERE name LIKE 'Ga%'; INSERT INTO Employee VALUES (5,'Thamali',6);
DELETE FROM Employee WHERE name LIKE 'Sa%'; COMMIT;	
	DELETE FROM Employee WHERE name LIKE 'Ni%'; COMMIT;

i. Suppose that the table is initially empty, the transactions are run at isolation level READ UNCOMMITTED, and the commands are issued in the order indicated above. What would be the content of Employee table after the execution? Explain your answer.

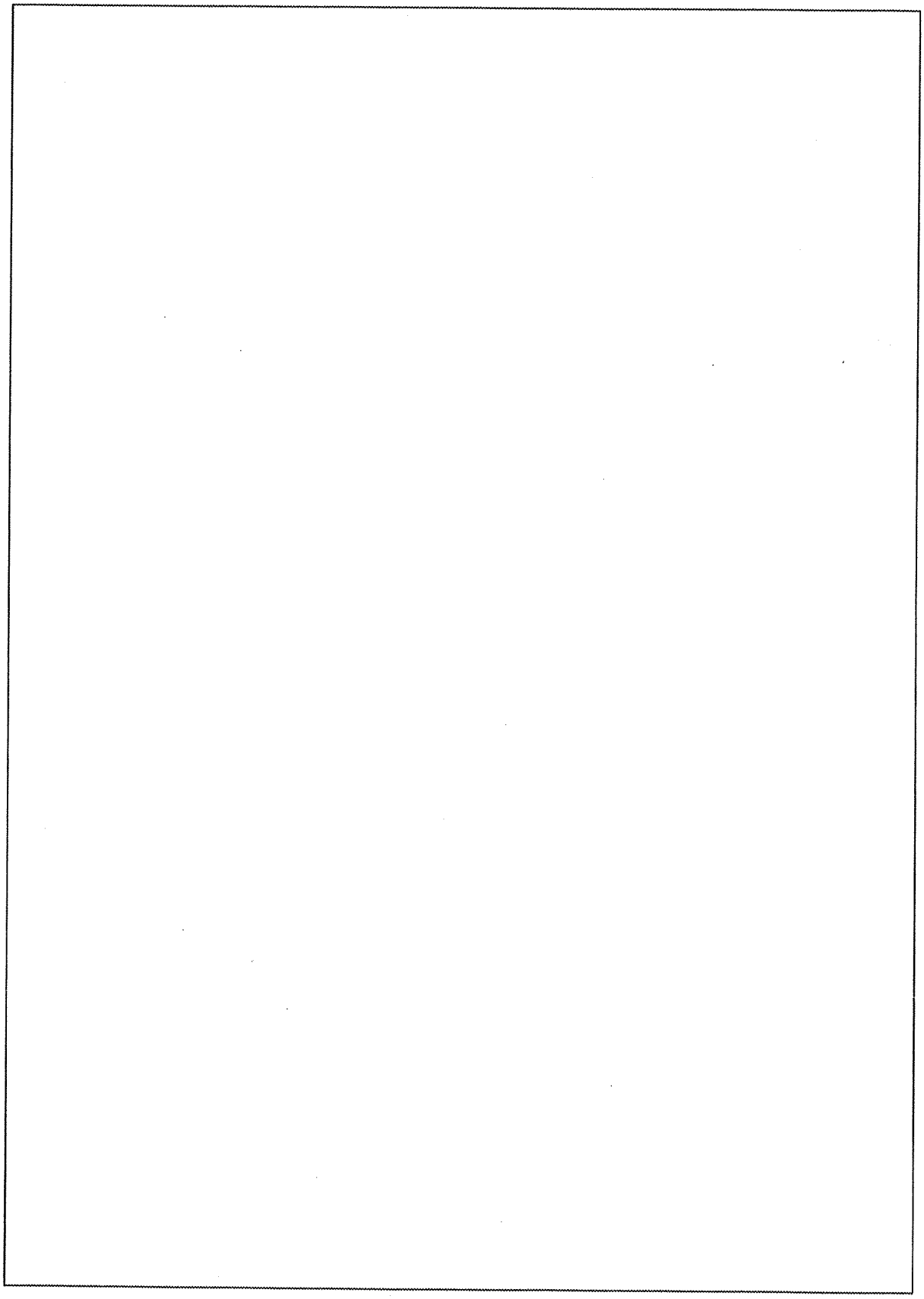
[3 Marks]

ii. Suppose that the table is initially empty, the transactions are run at isolation level READ COMMITTED, and the commands are issued in the order indicated above. What would be the content of Employee table after the execution? Explain your answer.

[3 Marks]

(d) Concurrent execution of transactions can cause problems to the database. Briefly explain four (4) problems that can occur due to concurrent execution of transactions with appropriate examples.

[8 Marks]



3. (a) Consider the schema given below with the following statistics:

Student (Studid, SName, Address, ContactNo, Degree, GPA)

Consider that Student file is an ordered file which has 50,000 fixed-length records of size R = 100 bytes stored on a disk with block size B = 1024 bytes in an unspanned manner.

i. Calculate the number of disk blocks required to store the student file. [2 Marks]
ii. The number of block accesses if binary search is performed. [2 Marks]

i. ii.

Suppose that an index file is created to improve the performance. Each index entry is 20 bytes long and the index is a dense index.

iii. Calculate the total number of index entries. [2 Marks]
iv. Calculate the number of disk blocks required to store the index file. [2 Marks]
v. Calculate the number of block accesses if binary search is performed. [2 Marks]

iii. iv. v.

(b) Consider the relational schemas given below.

University(uName, state, enrollment);
Student(sID, sName, Zscore);
Apply(sID, uName, major, decision);

Create a trigger that accepts insertion into the student table, and checks the Zscore. If the Zscore of the inserted student is greater than 1.6 and less than or equal to 2.0, that student will be automatically applying to UCSC for a CS degree, IIT for IS degree and NIBM for IT degree.

[5 Marks]

(c) Consider the relational schemas given below.

Part (Partid, Part_name, Stock_qty, Reorder_level)
Reorder (Partid, Reorder_qty, Received)

Write down following stored procedures.

i. Procedure **Del_reorder** to delete the record of a given Partid when the Received status is 'Y'. [3 Marks]

ii. Procedure **Update_stock** to update the *Stock_qty* with respect to a given quantity (which is the quantity sold) for a given Partid. [3 Marks]

i.

ii.

(d) Consider the following SQL script.

```
CREATE TABLE Employee(EmpID CHAR(5)
                ,Fname VARCHAR(25) NOT NULL
                ,Lname VARCHAR(25) NOT NULL
                ,Salary Float
                ,ProID CHAR(6)
                ,CONSTRAINT emp_pk PRIMARY KEY (EmpID));

CREATE TABLE Project(pID CHAR(4) PRIMARY KEY
                ,Name VARCHAR(25)
                ,Client VARCHAR(25));
```

(i) Change the SQL script to enforce an additional constraint called **ck_project** that would be applied to check whether the project ID of all the employees are between 1 and 5.

[2 Marks]

(ii) Change the SQL script to enforce an additional constraint called **fk_project** that would ensure data integrity between both the Employee and Project Tables.

[2 Marks]

4. Suppose you are designing a system to connect universities worldwide to share their research findings and papers. This will allow other university students and professors to contribute for ongoing research activities.

   (a) How would you apply CAP theorem on this? Explain your answer.

   [4 Marks]

   (b) How would you deal with the tradeoff property of the above (in part 4.a)?

   [4 Marks]

(c) How could the sharding be done with this system?

[2 Marks]

(d) The shards would be kept in different regions.

i. What is the main benefit of replicating shards?

[1 Mark]

ii. In the case of a region having multiple shards. If each machine contains a shard and a replica, how would you arrange the replication?

[4 Marks]

(e) You have been given a task to provide a search facility based on research areas and interests of research students / professors. There is a higher chance of introducing more such relationships in future. What is the type of database you are recommending for this functionality? Explain your answer.

[4 Marks]

(f) There is a requirement of providing an advanced search facility in finding research papers. Certain keywords are given as the search parameters. The search facility should find the most relevant research papers. Assume, you have given access to a synonyms service that gives similar words. Explain how would you fulfil the above requirement.

[6 Marks]

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