BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 6 Professional Graduate Diploma in IT

ADVANCED DATABASE MANAGEMENT SYSTEMS

Friday 20th March 2020 – Afternoon

Answer **any** THREE questions out of FIVE. All questions carry equal marks.

Time: THREE hours

Answer any Section A questions you attempt in Answer Book A
Answer any Section B questions you attempt in Answer Book B

The marks given in brackets are **indicative** of the weight given to each part of the question.

Calculators are **NOT** allowed in this examination.

SECTION A

Answer Section A questions in Answer Book A

A1.

This question relates to concurrency control in the context of a multi-user on-line transaction processing environment.

a) Write short notes to explain each of the following terms that are applied to concurrency control of interleaved transactions:

i) **serializable** (schedule);
ii) **isolation level** (of transactions);
iii) **exclusive and shared locks**.

(9 marks)

b) Explain, using examples of transaction sequences, the following problems that can occur during concurrency control:

i) Dirty Read / Uncommitted dependency;
ii) Cascading rollback.

Use the following transactions to provide examples in your answers.

Transaction 1

```
UPDATE EMPLOYEE
SET SALARY = 10000 WHERE EMP_ID= '123';
COMMIT
```

Transaction 2

```
SELECT * FROM EMPLOYEE;
```

(6 marks)

c) Explain how a **Dirty Read** would be prevented if a strict isolation level was used.

(3 marks)

d) Explain how a write-ahead (redo) log is used to recover a database server that has suffered from a catastrophic failure (for example following loss of power).

(7 marks)

[Turn Over]

A2.

This question relates to XML and related technology.

a) Consider the following XML extract:

```
<!ELEMENT class (student)*>
<!ELEMENT student (name, college, course*, (phone|email))>
<!ELEMENT name (#PCDATA)>
<!ELEMENT college (#PCDATA)>
<!ELEMENT course (title, year)>
<!ELEMENT title (#PCDATA)>
<!ELEMENT year (#PCDATA)>
<!ELEMENT phone (#PCDATA)>
<!ELEMENT email (#PCDATA)>
```

Using a small sample of data elements derive a XML document that would comply with the above DTD. Justify your answer.

(8 marks)

b) Table based mapping is one approach used to map an XML document to Tables in a Relational database. Explain how Table based mapping works and comment on the benefits and drawbacks of this approach.

(7 marks)

c) In recent years alternatives to the Relational data model have emerged. Describe the key characteristics of each of the following data models:

i) The Document Oriented;
ii) A Spatial/Geographical.

(10 marks)

[Turn Over]

A3.

a) One of the techniques used during query processing is to perform selection operations as early as possible. Explain the benefit of such a technique.

(2 marks)

b) Consider the following table:

```
employees (empID, name, salary)
```

The table is stored on a disk file containing 40 blocks and the primary key index is a B-Tree with 3 levels and 20 leaf nodes.

For **EACH** of the following queries, state how the query is to be executed (e.g. full table scan, full index scan, etc.) and calculate the associated cost (in number of blocks):

i) `SELECT empID FROM employees;`

ii) `SELECT name FROM employees WHERE empID = 120;`

iii) `SELECT * FROM employees WHERE salary > 15000;`

(9 marks)

c) SQL imposes a precedence rule on the use of the logical operators `AND` and `OR`.

i) Using an example of your choice, illustrate how this precedence works.

(2 marks)

ii) Explain how a hacker could take advantage of this precedence rule during an SQL injection attack.

(4 marks)

d) In the context of database security, briefly explain the difference between system privileges and object privileges and give an example of **EACH**, including the appropriate SQL statement.

(8 marks)

[Turn Over]

SECTION B

Answer Section B questions in Answer Book B

B4.

Using your own suitable example code and diagrams, explain how the following database concepts are implemented:

(a) Trigger;

(5 Marks)

(b) Function;

(5 Marks)

(c) Cursor;

(5 Marks)

(d) View;

(5 Marks)

(e) Stored Procedure.

(5 Marks)

B5.

a) Describe the defining characteristics of a **data warehouse** and how it differs in content and purpose from an OLTP database. Use appropriate diagrams and examples.

(10 Marks)

b) Explain, using suitable examples and diagrams where appropriate, how a data warehouse is populated, paying particular attention to the **ETL process**. Explain this process, taking care to highlight the key points of **EACH** stage, along with common problems or issues in **EACH** stage.

(15 Marks)

End of Examination