BCS THE CHARTERED INSTITUTE FOR IT

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

ADVANCED DATABASE MANAGEMENT SYSTEMS

Thursday 27th September 2018 - Morning
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 online transaction processing environment.

a) The following transaction runs in a highly concurrent database application (for example, sales order processing).

```
    .
UPDATE customer
SET discount = discount+0.03
WHERE customerArea = 'Glasgow'
COMMIT;
```

(i)   Give a definition of a database transaction.

(3 marks)

(ii)   Assume the UPDATE fails to COMMIT and is unable to fully complete its execution.

Explain the effect this might have on database integrity, assuming there were no concurrency control mechanisms.

(3 marks)

b) Optimistic and Pessimistic Concurrency Control use different strategies and techniques to achieve database integrity.

(i)   Explain the overall objectives of an Optimistic Concurrency Control strategy

(2 marks)

(ii)   Explain the overall objectives of a Pessimistic Concurrency Control strategy

(2 marks)

(iii)   Describe a Pessimistic Concurrency Control technique.

(5 marks)

(iv)   Describe an Optimistic Concurrency Control technique.

(5 marks)

c) Explain the concept of **deadlock**. Give an example of how deadlock would occur during concurrency control.

(5 marks)

A2

a) In Advanced Data Modelling, Object Oriented (OO) concepts are often used to extend traditional Entity Relationship (ER) data modelling.
Using a stated diagramming notation (such as UML Class diagrams), provide examples that show how these OO concepts are applied.

(8 marks)

b) A simple definition of the Object Oriented (OO) paradigm is that it is a method of programming based on a hierarchy of classes, well defined and cooperating objects.

Given the above definition: -

i)   Explain the *mismatch* that occurs when interfacing the relational data model with an OO programming language.

(9 marks)

ii)   Describe **ONE** of the following technologies and explain how they support the task of interfacing an OO program with a relational database.

- **JDBC**: Java Database Connectivity.
- **ORM:** Object Relational Mapping.

(8 marks)

A3

(a)   You run a query twice and notice that the second run took less time compared to the first one. Briefly explain why this is the case.

(2 marks)

(b)   Depending on the situation, a query optimiser can have three options when selecting data from a table:

(i) Use the table only.

(3 marks)

(ii) Use the index only.

(3 marks)

(iii) Use both the index and the table.

(3 marks)

For each of the above options, describe a situation where that option might be used. Support your answers with examples.

(c)   You have the following tables containing thousands of rows:
Film (filmNbr, title, year)
Director (directID, name)
Directing (directID, filmNbr)

And the following query:

```
SELECT Film.title
FROM  Film
JOIN Directing
ON Film.filmNbr = Directing.filmNbr
JOIN Director
ON Director.directID = Directing.directID
WHERE Director.name = 'Lucas';
```

The query takes a long time to run. You decide to check the Execution Plan which reveals the following:

- Each table is accessed by a full scan of the table.

- Both joins are of type sort-merge or merge.

(i)   Based on knowledge of the working of the sort-merge or merge-join, describe the sequence of operations that is likely to take place when executing the query.

(4 marks)

(ii)   Which operation(s) in the above query are likely to contribute more to its poor performance?

(1 mark)

(iii)   Explain why increasing the available memory for the processing of this query can enhance its performance.

(3 marks)

(d)   In order to save costs, an Internet Service Provider (ISP) hosts both the website and the database of a company on the same web server. Discuss the disadvantage of this decision from a security point of view.

(2 marks)

(e)   Describe two examples in which triggers can be used to secure data in a database.

(4 marks)

SECTION B

Answer Section B questions in Answer Book B

B4

(a)   Using appropriate e*xamples and diagrams*, explain in your own words what the following database concepts mean:

(i)   Horizontal Fragmentation.

(5 marks)

(ii) Vertical Fragmentation.

(5 marks)

(iii) Replication.

(5 marks)

(b)   Using suitable *code examples and diagrams*, explain how the following database concepts are implemented:

(i)   Triggers.

(5 marks)

(ii) Code Modularity.

(5 marks)

B5

(a)   Describe the key characteristics of a *data warehouse* and how it differs in content, structure and function from an *online transaction processing (OLTP)* database. You should support your discussion with suitable diagrams and examples.

(10 marks)

(b)   For each of the following items, explain the underlying concepts, typical applications and any additional technical or implementation points if appropriate. Support your discussion with suitable diagrams and/or examples.

(i)   OLAP
For example, *discuss different implementations of OLAP, SQL and OLAP, aggregation*

(5 marks)

(ii)   Multi-Dimensional Data
For example, *discuss roll-up, pivoting and what each dimension could represent,*

(5 marks)

(iii)   Data Mining
For example, *discuss patterns in data, techniques to identify these, data preparation, tools and predictions*

(5 marks)