BCS The Chartered Institute for IT

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

ADVANCED DATABASE MANAGEMENT SYSTEMS

Monday 4th October 2010 - 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

QUESTION 1

a) Mapping a database into XML becomes a process for some open framework applications.

Use the following tables (Table 1.1 and Table 1.2) and XML code (Listing 1.1) to explain the relationship between relational tables and XML documents. **(15 Marks)**

b) Using the XML code (Listing 1.1), create DTDs or schema. **(10 Marks)**

Table 1.1 Student

StudentNo	StudentName	CourseCode
S1	Jack	CS
S2	Martin	SE
S3	Sue	DB

Table 1.2 Course

CourseCode	CourseName
CS	Computer Science
SE	Software Engineering
DB	Database

Listing 1.1: XML code for above tables

```
<COURSE>
<course courseCode='CS'>
        <courseName>Computer Science</courseName>
                <Student courseCode='CS'>
                <studentNo>S1</studentNo>
                <studentName>Jack</studentName>
                </student>
</course>
```

Listing 1.1 continues overleaf

```
<course courseCode='SE'>
        <courseName>Software Engineering</courseName>
                <Student courseCode='SE'>
                <studentNo>S2</studentNo>
                <studentName>Martin</studentName>
                </student>
</course>
<course courseCode='DB'>
            <courseName>Database</courseName>
                <Student courseCode='DB'>
                <studentNo>S3</studentNo>
                <studentName>Sue</studentName>
                </student>
</course>
</COURSE>
```

Question 2

Query optimisation is often used in the transformation process of a query. Explain what role query optimisation plays in the following queries during transformation. In each case write the equivalent relational algebra statements to illustrate your answer.

Query 1

$\sigma_{\text{courseNo = 'CS01' ^ students > 50 (lecturer)}} = \sigma_{\text{courseNo= 'CS01'}} (\sigma_{\text{students>50(lecturer)}})$

(8 Marks)

Query 2

$\text{Lecturer} \bowtie_{\text{Lecturer.courseNo =course.courseNo}} \text{Course=Course} \bowtie \text{Lecturer}_{\text{Lecturer.courseNo =course.courseNo}} \text{Lecturer}$

(8 Marks)

Query 3

$$\Pi_{\text{roledepartment,courseNo}}(\text{Lecturer} \bowtie_{\text{LecturercourseNo=course.courseNo}} \text{course}) = (\Pi_{\text{role,courseNo}}(\text{Lecturer}) \bowtie_{\text{LecturercourseNo=course.courseNo}} (\Pi_{\text{department,courseNo}}(\text{course}))$$

(9 marks)

Question 3

a) With the rapid development of Internet technology, *database driven web sites* have become an essential component for enterprise applications.

Give example(s) of software architecture(s) for a *database driven web site*, including an explanation of the relevant services and programming languages that are required.

(15 Marks)

b) Explain what functions have been provided by the following code examples and which language is used in this example.

```
$host="localhost";
$user="usera";
$password="usera12";
$database="userdb";
$linkid=mysql_connect($host,$user,$password);
                if ($linkid==FALSE) {
                        echo ("Failed to connect to host $host <br />");
                        exit;
                        }
echo ("the connection to server $host was successful<br />");
                        $linkid=mysql_select_db ($database);
                        if ($linkid==FALSE) {
                        echo ("failed to connect database $database <br />"); exit;
                        }
echo (" the link to database $database was successful<br />");
```

(10 Marks)

Section B

Answer Section B questions in Answer Book B

QUESTION 4

a) Define the term *serialisability* in the context of transaction management. Show with the aid of an example how it is possible to determine if two database transactions can execute concurrently.

(10 marks)

b) Demonstrate how the effect of serialisability is manifested and maintained in EACH of the following techniques:

i) Timestamp algorithms
ii) Optimistic concurrency control
iii) 2 phase Locking

(15 marks)

QUESTION 5

a) Express Table 5.1 below as a hierarchical data structure

(5 marks)

Table 5.1 Table Assembly

ASSEMBLY_ID	ASSEMBLY_NAME	PARENT_ASSEMBLY
100	Automobile	null
110	Combustion Engine	100
111	Piston	110
112	Air Filter	110
113	Spark Plug	110
114	Block	110
115	Starter System	110
116	Alternator	115
117	Battery	115
118	Starter Motor	115
120	Body	100
121	Roof	120
122	Left Door	120
123	Right Door	120
124	Bracket	122
124	Bracket	123
130	Interior	100

b) The 'WITH' clause is part of the SQL-99 standard and is used to query a table recursively. Suppose the table above (table 5.1) is accessed by the following program.
Using an example call of the stored procedure explain how the following program (Listing 5.1) implements recursion.

(12 marks)

Listing 5.1

```
CREATE PROCEDURE Getsubcomponents(@root int)
AS
WITH SubAssembly
AS
(
  SELECT AssemblyID, 0 AS lvl  FROM Assembly
  WHERE AssemblyID = @root
  UNION ALL
  SELECT C.AssemblyID, S.lvl + 1
  FROM SubAssembly AS S
  INNER JOIN Assembly AS C ON C.ParentAssemblyID = S.AssemblyID
)
SELECT * FROM SubAssembly
```

c) Describe the factors that would affect the performance of the execution of the stored procedure given above (Listing 5.1)

(8 marks)