BCS THE CHARTERED INSTITUTE FOR IT

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

ADVANCED DATABASE MANAGEMENT SYSTEMS

Monday 22nd September 2014 – 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

The increase in global communication through the internet has resulted in a rise in the deployment of databases connected by XML web services.
Describe how each of the following objectives are realised by the use of XML based web services technology

- The integration of database services over the WWW,
- Data can travel freely over the WWW,
- The means by which a DBMS consumes and generates XML data.
- Strong Data independence
- Loose coupling of physically distributed databases

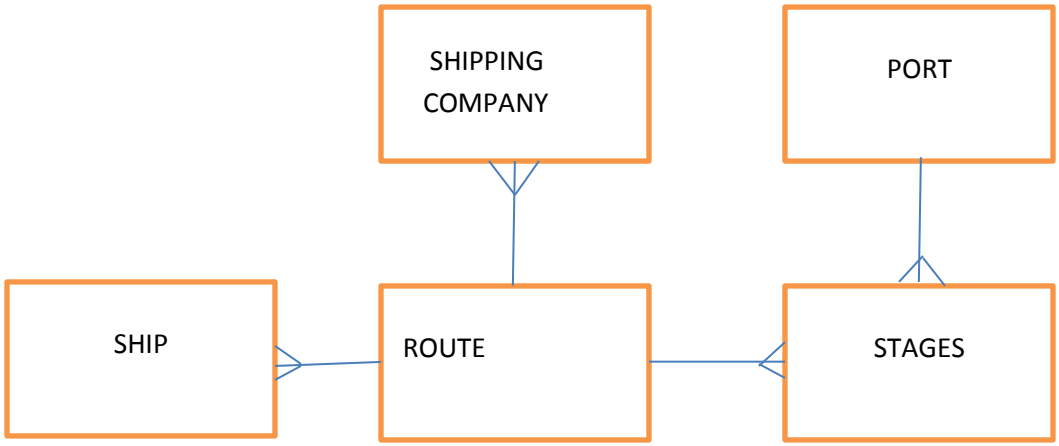
Include in your answer sample code illustrating the role of the following key technologies:
The Simple Object Access Protocol (SOAP),
Web Services Description Language (WSDL),
Universal Description Discovery and Integration (UDDI)

(25 marks)

A2

a) The sample ERD (Figure A2 below) describes a scenario in which there are many shipping companies that own a number of ships that travel from one port to another. A ship follows a prescribed route consisting of stages which consists of a number of ports that are visited on the route starting from and finishing at a ships home port. A ship journeys over one route but a route may be used by many ships. A route is also covered by many shipping companies but a company only travels over one route.

Figure A2 ERD of a shipping company



With reference to the ER model Figure A2

(i) Explain the problem known as *fan trap*. Identify a potential *fan trap* in the above ER model and show how this is resolved.

(6 marks)

(ii) With aid of an example explain the problems caused by a *chasm trap* and explain how this might be resolved.

(7 marks)

b) With reference to the scenario below show how Object Oriented modelling concepts can be used to model Aggregation and Inheritance and explain how these constructs are translated to database tables/relations.

(12 marks)

A ship carries a cargo and a crew. Crew are personnel with different responsibilities – maintenance, navigation, catering and loading. Loading crew are contractors that are not employed by the shipping company. Maintenance crew are assigned properties that reflect their speciality. A transport job involves transporting cargo consisting of different products that are stored in containers. Each container may hold one or many products. There may be none, one or many containers transported on a ship between visits to ports. Containers can be of a standard size or a large size but some containers are of a special type of load, these being either Refrigerated or Hazardous. Containers are either loaded or unloaded during the visit of a ship at a port.

A3

a) Consider the following table:

employees (<u>empID</u>, name, salary)

The table is stored on a disk file consisting of 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;`

(3 marks)

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

(3 marks)

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

(3 marks)

b) The SGA (System Global Area) is a shared memory area in an Oracle database instance. Describe its role in achieving good query performance.

(4 marks)

c) Security is a major concern in database systems.

(i) Describe four of the main threats to database security.

(4 marks)

(ii) Using examples, discuss how Triggers can contribute to the security of a database, before and after a security breach.

(4 marks)

(iii) Describe two mechanisms for guarding against SQL injection.

(4 marks)

Section B

Answer Section B questions in Answer Book B

B4

a) How does a *data warehouse* differ in function, content and structure from an *OLTP database*?

(5 Marks)

b) For each of the following items, explain what the term means, the underlying concepts involved, any associated benefits or limitations, typical applications and features. You should support your discussion with suitable diagrams and/or examples.

(i) OLAP, its varieties, the role of aggregation and the impact on SQL

(5 Marks)

(ii) Data Mining, associated algorithms/techniques and data cleaning

(5 Marks)

(iii) Multi-Dimensional Data, dimensional analysis, roll-up and pivoting

(5 Marks)

c) Explain the term ‘ETL’ with respect to data warehousing. Highlight common techniques, problems or issues in each stage of the use of ETL.

(5 Marks)

B5

(a) In your own words, define the following database terms…

(i) Transaction

(2 Marks)

(ii) ACID properties

(2 Marks)

(iii) Isolation levels

(2 Marks)

(iv) Locking levels

(2 Marks)

You should support your discussion with suitable examples and/or diagrams.

(b) Using your own examples and/or suitable diagrams, explain the following *transaction processing* concepts and their role in enforcing data integrity and consistency…

(i) COMMIT

(2 Marks)

(ii) ROLLBACK

(2 Marks)

(iii) SAVEPOINT

(2 Marks)

(c) Using your own examples and/or suitable diagrams, explain how the TWO-PHASE COMMIT protocol may be needed in a distributed database environment and why the above concepts in part (b) may be inadequate to ensure data integrity and consistency in such a distributed environment. You are specifically advised to address the following concepts:

- The two stages of the TWO-PHASE COMMIT protocol
- Global and local transactions
- Inter-site communication during the TWO-PHASE COMMIT protocol
- The impact of partial success and ACID rules

(11 Marks)