BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 5 Diploma in IT

DATABASE SYSTEMS

Tuesday 27th March 2018 - Morning
Answer FOUR questions out of SIX. All questions carry equal marks.
Time: TWO hours

Answer any <u>Section A</u> questions you attempt in <u>Answer Book A</u>
Answer any <u>Section B</u> questions you attempt in <u>Answer Book B</u>

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

a) Explain the MAIN objectives of the ANSI-SPARC architecture for a DBMS. Discuss briefly the challenges of achieving these objectives in practice.

(10 marks)

b) Nowadays, many organisations have chosen to have their data resources and services managed remotely by hosting databases on the 'Cloud'.

Describe the concept of the 'Cloud' and explain how it differs from a client-server database architecture. Comment on the advantages of running an organisation's database resources and services on the 'Cloud'.

(15 marks)

A2

The integrity of database transactions must be maintained in a highly concurrent multi-user online transaction processing environment.

Given the above context, describe the techniques a DBMS uses to maintain database integrity.

For guidance, your answer must address, with the aid of relevant examples, the following five topics:

a) What function is performed by a **TYPICAL** database transaction compared to a program that reads/writes to a traditional file-based system?

b) How database integrity is affected by concurrent transactions.

c) Why database transactions have to be isolated to preserve database integrity.

d) What happens when transactions have to be aborted?

e) How the DBMS recovers transactions that are lost following system failure or crashes.

(25 marks)

A3

a) Each member of staff in a company is allocated a single computer. Information about computers belonging to staff members is stored in a database consisting of the following table:

HasComputer (StaffNbr, ComputerNbr, Manufacturer, Cost)

Company policy subsequently changes and some staff are allocated more than one computer (Each computer is still assigned to a single member of staff).

(i) Explain why the above table design is no longer appropriate. **(1 mark)**

(ii) Suggest a new database design to handle the new situation. **(4 marks)**

b) Each member of staff in a company works on a single project. Several staff work on each project, and all staff working on the same project share the same office. The following table stores information about staff, projects and offices.

Works (StaffNbr, ProjectNbr, ProjectDescription, OfficeNumber)

(i) Explain how an update anomaly could arise in the above table.

(2 marks)

(ii) Identify the underlying fault in the above design, and show how the table can be transformed to remove this flaw.

(6 marks)

(iii) Suppose the situation is as described above, except that now each project has just ONE member of staff working on it. Is the original table design still faulty? Explain your answer.

(2 marks)

(c) The following table keeps records of medical consultations conducted in a medical practice. Each consultation takes place in a room and is conducted by a doctor on a patient. A patient cannot have two consultations on the same day.

patientNbr	consultationDate	consultationTime	doctorNbr	roomNbr
P01	13-Sep-17	08:30	D01	R01
P01	18-Sep-17	15:00	D02	R02
P02	13-Sep-17	10:00	D01	R01
P03	13-Sep-17	10:00	D02	R02
P04	26-Sep-17	08:30	D01	R02

(i) Explain what is meant by a "functional dependency" between attributes in a table.

(2 marks)

(ii) Identify two functional dependencies from the above table.

(6 marks)

(iii) Suggest a suitable primary key for the above table.

(2 marks)

Section B
Answer Section B questions in Answer Book B

B4

A **database designer** is bidding for a new contract with a prestigious blue-chip organisation. Part of the selection process is a technical interview. Answer the following questions from the interview panel.

(a)   Explain, with examples, how a database table may be logically connected to another table, including the associated rules demanded by *referential integrity* to support such connectivity and any subsequent changes in either table.

(10 Marks)

(b)   Explain, with examples, how the rows in a given database table may be uniquely identified, including the associated rules demanded by *entity integrity* and what guidelines exist for the selection of such a row-identification mechanism.

(10 Marks)

(c)   Show how appropriate relational algebra operations would be used to extract
   (i)   specific tuples.
   (ii)   specific attributes.
   (iii)   specific attributes of specific tuples from a populated database table.   **(5 Marks)**

B5

A **SQL developer** is bidding for a new contract with a prestigious blue-chip organisation. Part of the selection process is a technical interview. Answer the following questions from the interview panel:

a)   For each of the following terms, explain what the term stands for, the essence of the functions it provides and a set of example SQL statements (at least TWO for each) that implement these functions:

   (i)   DDL.   **(5 Marks)**
   (ii)   DML.   **(5 Marks)**
   (iii)   DCL.   **(5 Marks)**

b)   Using your own specific examples, illustrate the following SQL querying techniques:

   (i)   Row-level filtering.

                                                                               (2 marks)
   (ii)   Aggregate functions.

                                                                               (2 marks)
   (iii)   Grouping and group-level filtering.

                                                                               (2 marks)
   (iv)   Joining.

                                                                               (2 marks)
   (v)   Sub-Queries.

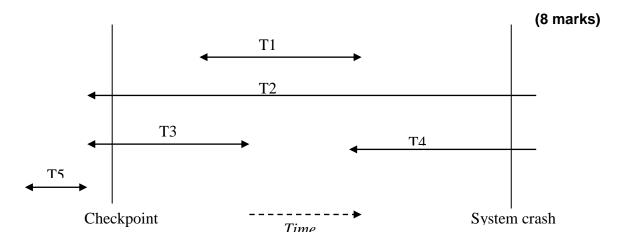   **(2 marks)**

(a) Database management systems have to make provision to recover from situations such as system crashes.

(i) Explain what is meant by a *log* file, its typical content, and why it is required for recovery.

(3 marks)

(ii) Explain what is meant by the *deferred update recovery protocol*.

(2 marks)

(iii) Consider the following series of transactions, which you may assume took place using the *deferred update recovery protocol*. The arrowheads represent the start and end points of the transactions. For each transaction, explain how the recovery process deals with that transaction.

(8 marks)

(b) The following table gives information about staff in a company:

StaffID	StaffName	ProjectNbr	PhoneNbr	Salary
S1	Fred	P3	1234	20000
S2	Bill	P3	1235	25000
S3	George	P5	1267	19000
S4	Jim	P5	1294	19500

It has been decided to develop a number of views based on this table for the convenience of the users. Give an example of a horizontal view of this table, and an example of a vertical view, and explain why each might be useful. (In each case, just list the contents of the view; you are not required to write any SQL, for example CREATE VIEW statements).

(4 marks)

(c) Relational databases are very effective in situations for which they are appropriate. In other situations, simpler file-based solutions may be sufficient. Suppose you are required to implement a system for storing information about a library's books, borrowers, and loans. Give FOUR reasons why a database system is superior to a file-based system for this task. Illustrate the answer with suitable examples.

(8 marks)

END OF EXAM