BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS

BCS Level 5 Diploma in IT

DATABASE SYSTEMS

Friday 29th March 2019 - Morning

Answer **any** FOUR questions out of SIX. All questions carry equal marks
Time: TWO 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

a) A fundamental feature of a DBMS is to support *Data Independence.*

Define the term *Data Independence* and distinguish between logical and physical data Independence

(3 Marks)

b) Explain how *Data Independence* can benefit the database professional when designing, building and implementing applications that use a database.

(5 Marks)

c) An Examination Processing System (EPS) uses spreadsheets to collect and store exam marks. An examiner enters exam marks for a particular subject taken by hundreds of candidates. There are around ten different subjects, with the marks entered for each subject stored in a separate spreadsheet file. The spreadsheets calculate and records such data as the average mark for each question, the percentage of passes, and number of attempts in each subject. There is also a need to produce information on the overall performance of candidates across the examinations such as number of exams passed.

Assume the organisation that runs EPS, uses a DBMS for other related tasks such as registering/enrolling candidates, and is considering storing and processing all marks and calculations using a database.

i) Discuss the advantages and disadvantages of using a spreadsheet approach.

(4 Marks)

ii) Discuss the reasons why it might be desirable to move the data that is collected by EPS in spreadsheet files into a set of database tables.

(4 Marks)

d)

i) Views have a number of properties that make them attractive for use in database applications. The main properties are listed below:

1. Enhancing security by restricting access to particular sets of rows or columns in a base table.

2. Hiding complexity in complex queries by maintaining a query that might be difficult to formulate.

3. Simplifying statements output of queries for the end user by representing data in a different perspective from that of the base table.

4. Isolating applications from changes in definitions of base tables.

5. Showing derived data from data stored in tables.

Choose three of the above properties, and for each one in turn write a SQL statement that would create a view based on the T1 table (shown below) that has that property. Explain how and why each of your views supports the chosen property. Illustrate this by including the view in a sample `SELECT` statement.

(9 marks)

T1

EmployeeID	EmployeeName	Monthly_Salary	JobTitle	Department
231	Jones	3400	Chemist	BIOTECH
232	Mathews	2200	Secretary	HR
233	Kohli	5500	Director	HR
234	Kane	5800	Director	MECH
235	White	2750	Technician	ENG
236	Black	2800	Chemist	BIOTECH

A2

a) What is the overall function of a transaction manager of a DBMS?

(5 Marks)

b) Explain how EACH of the following properties of a database transaction guarantee consistency

i) Atomicity

(3 Marks)

ii) Durability

(3 Marks)

c) A travel agent uses an online system to book seats on behalf of customers. Bookings are frequent and the seats are going fast. A customer has rung a travel agent to book two seats:
Customer: “Please book two tickets for Honolulu on the 10am flight”

Agent: “OK I’ll check if there are any seats available”

Customer: “Thanks also what is the price for two tickets”

Agent: “I have two seats available at the price of £1800 on flight 192 leaving 10am”

Customer: “Great I’ll take them”

Agent: “The screen has refreshed and the price has now gone up to £1900”

Customer: “No problem please book them”

Agent: “I’m very sorry I have just tried to reserve them and it seems they have been reserved by another agent. There is nothing available on that flight”

Describe, with aid of time line diagrams of concurrent schedules of transactions, a possible cause of the inconsistency that has occurred in the scenario.

(8 Marks)

d) Explain how the above inconsistency in A2c) can be resolved using transaction locking.

(6 Marks)

A3

A department consists of multiple members of staff, although any member of staff may not necessarily belong to a department. A department has a unique ID, and a name. A member of staff is also identified by an ID and has a name. Any number of staff can take part in a meeting. The time spent by each member of staff in any given meeting is recorded. A meeting has a unique ID and a description and is booked in a given room. A room has a unique ID and a description. Not all rooms are appropriate for hosting meetings.

a) Using a modelling notation of your choice, draw an Entity-Relationship model for the scenario above, showing:

- The entity types, with corresponding attributes and primary keys
- The relationships between those entities. For each relationship show their degree (One:One; One:Many or Many:Many) and participation (Mandatory or Optional)
- State any assumptions you make to fill any gaps in the scenario.

(13 Marks)

b) Design a set of tables derived from your Entity-Relationship model in part (a) above. Clearly highlight all primary keys and foreign keys. Fill in the tables with sample data that represents all of the degrees of the relationships. Limit the number of rows in any table to a maximum of 4 rows per table.

(12 Marks)

Section B
Answer Section B questions in Answer Book B

B4

a) With reference to a sample relation of your own choosing, explain and discuss the following relational model terminology, including its function in query processing and any related concepts. A good diagram showing your sample relation is strongly suggested.

i) Relationship Cardinality.

(3 Marks)

ii) Participation constraints.

(3 Marks)

iii) Recursive relationship.

(3 Marks)

iv) Composite Key.

(3 Marks)

v) Domain.

(3 Marks)

b) Define the functionality of the following keywords in SQL. Use examples to illustrate as necessary.

i) `HAVING`
ii) `UNION`
iii) `LIKE`

(10 Marks)

c) Consider the following employee data stored in the EMPLOYEES table shown below.

EMPLOYEES TABLE

EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_HIREDATE	JOB_CODE
101	News	John	G	08-Nov-00	502
102	Senior	David	H	12-Jul-89	501
103	Arbough	June	E	01-Dec-96	500
104	Ramoras	Anne	K	15-Nov-87	501
105	Johnson	Alice	K	01-Feb-93	502
106	Smithfield	William		22-Jun-04	500
107	Alonzo	Maria	D	10-Oct-93	500
108	Washington	Ralph	B	22-Aug-91	501
109	Smith	Larry	W	18-Jul-97	501

B5. Write SQL code for the following:

i) Show all attribute values for a job code of 502.

(2 Marks)

ii) Change the job code to 501 for the person whose employee number is 107.

(2 Marks)

iii) Restore the data to its original status - the table should contain the data that existed before you made the change in question (ii).

(1 Mark)

iv) Delete rows for people who were hired after August 1st, 2004 and whose job code classification is 500. **(3 Marks)**

v) Make the latest changes to the EMPLOYEES table permanent in the database

(1 Mark)

vi) Show the full employee names for all employees who do not have an initial of 'K' or 'W'.

(3 Marks)

vii) Find how many employees are in each job code.

(3 Marks)

d) Declarative constraints in the SQL language can be used to place restrictions and rules on data in the database. For each of the following constraints, explain the restrictions that are placed on the data when that constraint is used.

i) Primary Key.
ii) Unique Key.
iii) Foreign Key.
iv) Check.

(8 Marks)

e) When using foreign key constraints an option of `ON DELETE CASCADE` can be used. Describe the effect of using this option.

(2 Marks)

B6

a) This section focuses on the recording of teaching activity in a school called Schoolit. In earlier years, each teacher could teach only a single pupil, and each pupil had a single teacher. Information about teachers and their pupils was stored in the following table.

`Teaches(TeacherID,TeacherName,PupilID,PupilName,PupilGender)`

(i) Subsequently, the teacher called Smith proved able to teach many pupils at once. It was still the case, however, that each pupil had just one teacher. Explain why the `Teaches` table is no longer in 1st normal form.

(2 Marks)

(ii) Given that a teacher can now teach many pupils, show how the `Teaches` table can be converted into 1st normal form.

(3 Marks)

b) In a company, each member of staff reports to a single manager. Each manager has a single office. Information about staff and managers is stored in the following table.

`ReportsTo(StaffID,StaffName,ManagerId,ManagerName,ManagerOffice)`

(i) Explain what is meant by an anomaly in a database table?

(3 Marks)

(ii) Describe two different types of anomaly, and give an example of each with reference to the above `ReportsTo` table

(3 Marks)

(iii) Identify the underlying fault in the above `ReportsTo` table and show how the table can be transformed to remove this flaw.

(4 Marks)

c) At the school of computing, each student has a placement period with a single employer. Each student also has a single supervisor from the school, who visits him or her several times during the placement. At the end of every visit, a grade is awarded.

The following table is used to hold information related to placements:

`Placement(StudID,VisitNumber,StudName,EmpID,EmpAddress,Grade)`

(i) Explain what it means for a table to be in 2nd normal form.

(2 Marks)

(ii) Explain why the above table is not in 2nd normal form.

(2 Marks)

(iii) Show how the table can be transformed so that it is in 2nd normal form.

(4 Marks)

(iv) Consider the transformed table produced in part (iii). Is it now correctly designed, or could it still lead to anomalies? Explain your answer.

(2 Marks)

END OF EXAMINATION PAPER