

**BCS THE CHARTERED INSTITUTE FOR IT**  
**BCS HIGHER EDUCATION QUALIFICATIONS**  
**BCS Level 5 Diploma in IT**

**DATABASE SYSTEMS**

Friday 1<sup>st</sup> April 2016 – 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 <b>NOT</b> allowed in this examination.
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**Section A**

**Answer Section A questions in Answer Book A**

**A1**

Assume the following SQL script is to be executed :-

```
CREATE TABLE Students (StudentID CHAR(6)
                        ,StudentFname VARCHAR(20) NOT NULL
                        ,StudentLname VARCHAR(20) NOT NULL
                        ,Date_of_Birth DATE
                        ,CourseCode CHAR(6) ,
CONSTRAINT student_pk PRIMARY KEY (Studentid));

CREATE TABLE Courses (CourseCode CHAR(6) PRIMARY KEY
                        ,CourseLevel INT
                        ,Fee NUMBER(5,2));

INSERT INTO Students VALUES
('234349','Bill','Nomas', NULL,NULL);

INSERT INTO Students VALUES
('234350','Ramesh', 'Haslam', 22,'SET');

INSERT INTO Students VALUES
('234351','John','Norman', 24, 'GHR');

INSERT INTO Students VALUES
('234347','John','Sagatara', NULL, NULL);

INSERT INTO Students VALUES
('234350','Ramesh','Bartok', 22, NULL);
```

```
INSERT INTO Students VALUES  
( '234341', 'John', 'Norman', 24, NULL );
```

```
INSERT INTO Students VALUES  
( '234348', 'David', 'Bulmar', NULL, NULL );
```

```
INSERT INTO Students VALUES  
( '234345', NULL, 'Desai', NULL, NULL );
```

```
INSERT INTO Courses VALUES  
( 'GHR', 1, 249 );
```

- a) Classify TWO types of data integrity checks that have been specified to prevent invalid data being entered. Give examples of each of these types of data integrity checks.  
**(4 marks)**
- b) What is the result of running the above script (assuming it is syntactically correct) in terms of table creation and insertion of data?  
**(2 marks)**
- c) Change the script to enforce an additional constraint that would be applied to restrict the data of birth of all students to be later than 01-jan-1998.  
**(2 marks)**
- d) Change the script to enforce an additional constraint that would ensure data integrity between data referenced in both the Students and Courses Tables. Assume that a student can only attend one course at a time and a course may have many students.  
**(4 marks)**
- e) Why is it necessary to constrain updates performed on referenced data in tables such as Courses and Students? Explain the measures available in SQL to constrain these updates.  
**(5 marks)**
- f) Describe with the aid of example SQL code how data may be inserted into a table by selecting and copying data from one or more existing tables, hence avoiding the use of many INSERT statements  
**(4 marks)**
- g) Apart from containing sequences of SQL code in a script, describe other ways that SQL code can be stored, contained, encapsulated and run as a sequence of executable statements.  
**(4 marks)**

**A2****Study the following scenario**

A travel company provides a selection of **Hotels** that prospective customers can reserve prior to booking a room. A customer can select from a range of **Accommodation Types** that each hotel offers to suit their requirements. Details of the accommodation type include the catering facilities either Self Catering (SC); Half Board (HB); Full Board (FB). The bed type either Twin bed (T); Double bed (D); Suite (S). The price of the hotel is determined by the hotel and the type of accommodation offered.

Assume that

- Each hotel is identified by a hotel code.
- The accommodation type is identified by a unique accommodation type code.
- Accommodation is only available during the month of June in 2016.

Fig A2 below is a representative sample of data about hotels and the accommodation types offered by each hotel.

**Fig A2 Hotel Accommodation**

RESORT	HOTEL CODE	HOTEL NAME	CATERING	BED TYPE	ROOM PRICE	ACC_TYPE _CODE	MONTH
Benidorm	FLB	Flamingo	SC	T	159	12	June
Palma Nova	JDM	Jardin Del Sol	SC	T	195	12	June
Benidorm	AHB	Al Hambra	FB	D	199	15	June
Santa Ponsa	HAZ	Hawaii	HB	T	308	16	June
Playa Blanca	SPZ	Sun Park	FB	S	310	18	June
Benidorm	AHB	Al Hambra	HB	S	199	17	June
Palma Nova	JDM	Jardin del Sol	FB	S	199	18	June
Palma Nova	JDM	Jardin del Sol	FB	D	169	15	June
Benidorm	SPB	Sun Park	FB	S	159	18	June

- a) Derive an Entity Relationship data model for the above scenario according to the following requirements:-

(You may use any stated standard ER modelling notation and you must state any assumptions necessary but do not contradict the scenario)

- i) Entity Types that you model are listed in bold font

**(2 marks)**

- ii) Show Relationships and participation constraints

**(5 marks)**

- iii) Resolve Many to Many relationships

**(4 marks)**

- iv) Allocate attribute types to Entity Types using the column headers from Table A2. Underline attributes that are Entity Identifiers.

(4 marks)

- b) Derive a set of Tables/Relations from your ER model containing the sample data above. Underline the Primary Keys in each Table.

(5 marks)

- c) Extend the ER model you produced above in part a) by adding **TWO** further Entity Types; **Customer** and **Reservation**; to allow a Customer to reserve accommodation at a hotel possibly on different dates.

(5 marks)

### A3

- (a) A library uses the following table to store details of students, the books they have borrowed and when they borrowed them. The Primary Key is (StudentID, BookID).

#### Borrowing

<u>StudentID</u>	StudentName	<u>BookID</u>	BookTitle	Date
S1	Smith	B1	Python	12-Apr-2016
S1	Smith	B2	Databases	17-Jan-2016
S2	Ford	B1	Python	25-Feb-2016

- (i) Which Normal Form does the above table violate and why?

(3 marks)

- (ii) Give an example of an insert anomaly and an example of a delete anomaly that may occur if the table is left un-normalised.

(4 marks)

- (iii) Normalise the table to achieve 3<sup>rd</sup> normal form.

(5 marks)

- (b) An important concept in the theory of relational databases is that of a *functional dependency*.

- (i) Explain what is meant by a functional dependency and give an example.

(2 marks)

- (ii) Identify two functional dependencies in the following table (A, B and C are the names of the columns):

<b>A</b>	<b>B</b>	<b>C</b>
a1	b1	c1
a1	b1	c3
a1	b2	c1

(4 marks)

- (c) A football club uses the table below to record details of players and the positions in which they can play. Each player can play in up to a maximum of three positions:

<u>playerID</u>	playerName	Positions
P1	Lionel Messi	Forward, Centre Midfield
P2	Cristiano Ronaldo	Forward, Left Midfield, Right Midfield
P3	Philippa Lahm	Right Back, Defensive Midfield

- (i) Explain why this table is not in “First Normal Form” (1NF).

(1 mark)

- (ii) Show how this table can be transformed into 1NF tables. Give **two** possible solutions.

(6 marks)

## Section B

### Answer Section B questions in Answer Book B

**B4**

- (a) Relational Algebra (RA) consists of two sub-categories of operation:

- Those based on set theory and essentially borrowed from mathematics
- Those invented specifically for the manipulation of relations (not present in set theory)

For EACH sub-category, name, describe, draw and illustrate (using your own examples) THREE separate RA operations, making a total of SIX operations. Good diagrams will gain extra credit.

Each operation is worth up to three marks.

(18 marks)

- (b) Those data sets operated upon by operations drawn from set theory have to abide by a particular criterion that data sets being manipulated by the other operations do not. What is this criterion and what restrictions does it place upon the relevant data sets?

(7 marks)

## B5

- (a) The database is only one component in a larger IT infrastructure. Using your own simple examples and any diagrams you feel suitable, explain how

- 1) The 2-Tier and 3-Tier architectures work
- 2) The interfaces differ across those architecture
- 3) The split between the traditional data and logic tiers works within these environments.

(15 marks)

- b) Explain what the term *data validation* means. Using your own examples, describe the various data validation techniques that may be embedded into a forms-based interface to a database – for example, ensuring that the correct type and range of data values are entered.

(10 marks)

## B6

- (a) Explain what is meant by a transaction and why it is an important unit of operation in a DBMS?

(2 marks)

- (b) Suppose we have a table called students that, initially, has 120 records. **How many rows** will be in the table after executing the following commands? **Justify** your answer. Hint: the answer is one of the following: 0, 1, 122 or 123.

```
INSERT INTO students (stud_id) VALUES (120);  
SAVEPOINT stud120;
```

```
INSERT INTO students (stud_id) VALUES (121);  
SAVEPOINT stud121;
```

```
INSERT INTO students (stud_id) VALUES (122);  
SAVEPOINT stud122;
```

```
TRUNCATE TABLE students;
```

```
INSERT INTO students (stud_id) VALUES (123);
```

```
ROLLBACK;
```

(4 marks)

(c) Describe, with an example, one type of problem that can occur in a multi-user environment when concurrent access to the database is allowed. **(6 marks)**

(d) Backups of the database should be taken in order to protect data. Describe **five** measures that can be taken in order to ensure the security and effectiveness of database backups. **(5 marks)**

(e) Describe four possible benefits of “**Views**” in databases. **(8 marks)**