BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 5 Diploma in IT

DATABASE SYSTEMS

Thursday 28th September 2017 – 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 University Library holds a large stock of books that are available for loan to borrowers. The library requires a database to support the processing of these loans.

a) Examine the example records in the Forms (Figure 1) and the assumptions (Figure 2) shown below, then draw an Entity Relationship diagram that includes the following: -

- Entity types assigned with the attributes- (Indicate which attributes represent Primary keys).
- Relationships between the entity types. (resolve any many to many relationships)
- Relationship cardinality and optionality constraints.

State the modelling notation you have used and state any necessary assumptions you make.

(14 marks)

b) Draft a set of Tables derived from your ER diagram populated with sample data from Form1 in Figure 1 shown below. You are required to indicate which columns are primary keys and which are foreign keys.

(8 marks)

c) Show with the aid of a diagram how your Tables are interlinked. (Related through columns)

(3 marks)

Figure 1: Three sample forms recording loans of copies of books over a period of time

Form 1

Title: The Joy of E-R Modelling **Published_In** 2013 **ISBN**: 939757

Author Id: AU505 **Author Name** : Moss

Author Id: ----- **Author Name** : ------

CopyNo C1034 **Shelf Number** C100 **DateAcquired:** 12-APR-16

Borrower Id	Borrower Name	Borrower Dept	Loan Date	Return Date
A12	Bloggs	CIS	02-OCT-16	13-OCT-16
B34	Greenacre	Business	13-OCT-16	27-OCT-16

Form 2

Title: Normalisation is Fun and Easy **Published_In** 2010 **ISBN**: 549950

Author Id AU1911 **Author Name** :Bollinger

Author Id AU505 **Author Name** : Moss

CopyNo C2399 **Shelf Number**: C101 **DateAcquired:** 22-APR-2011

Borrower Id	Borrower Name	Borrower Dept	Loan Date	Return Date
B34	Greenacre	Business	04-OCT-16	18-OCT-16
L67	Franks	Leisure	22-OCT-16	29-OCT-16

Form 3

Title: Normalisation is Fun and Easy **Published_In** 2010 **ISBN**: 549950

Author Id AU1911 **Author Name** : Bollinger

Author Id AU505 **Author Name** : Moss

CopyNo C2400 **Shelf Number**: C101 **DateAcquired:** 25-JUN-2011

Borrower Id	Borrower Name	Borrower Dept	Loan Date	Return Date
A12	Bloggs	CIS	04-OCT-16	25 OCT-16
L67	Franks	Leisure	02-SEP-16	09-SEP-16

Figure 2: List of Assumptions

i. The library acquires one or many copies of books, these are physical copies of a particular publication.
ii. A publication has a unique ISBN (an international code for all published works); a title and the date it was published.
iii. Each copy has a unique copy number and has a particular shelf number to which it is located.
iv. A publication is always written by either one or two authors, and an author may write many publications.
v. Only authors who have written at least one publication will be stored.
vi. A borrower may have more than one copy on loan at any time.
vii. A borrower may yet to take out a loan.
viii. Over time a copy may be out on loan many times or it may never be loaned out.
ix. A loan is made by a single borrower for one copy of a publication.

A2

Refer to the following set of SQL statements and the sample tables for this question.

```
CREATE TABLE tickets(
       ticketno NUMBER
      ,purchasedate DATE
      ,custid NUMBER
      ,fixtureid NUMBER
      ,seatid VARCHAR(5));

CREATE TABLE fixtures(
       fixtureid NUMBER
      ,fixturedate DATE
      ,opposition VARCHAR(4));

CREATE TABLE customer(custid NUMBER
      ,custname VARCHAR(20)
      ,address VARCHAR(20));

CREATE TABLE seats(
       seatid VARCHAR(5)
      ,seatingarea VARCHAR(20)
      ,seat_type VARCHAR(20));
```

Sample tables

Table: seats

SEATID	SEATINGAREA	SEATTYPE
C11	West Stand	Reserved
C12	West Stand	
C13	West Stand	
MM3	West Upper	
MM4	West Upper	Reserved
MM59	West Upper	
H105	South Stand	Family
H106	South Stand	Family
H107	South Stand	
G2	East Stand	Away
G3	East Stand	Away
K4	North Stand	Disabled

Table: tickets

TICKETNO	PURCHASEDATE	CUSTID	FIXTUREID	SEATID
107823	13-Dec-2016	10032	8320	MM59
959235	13-Dec-2016	10032	8321	K4
309998	15-Dec-2016	13420	8322	MM3
306298	08-Mar-2017	13420	9767	MM3
736228	15-Oct-2016	13420	9770	C11
736229	15-Oct-2016	13420	8320	G2
736230	15-Oct-2016	17243	8320	C12
107922	13-Dec-2016	10035	8320	H105
107923	13-Dec-2016	10035	8320	H106

Table: `fixtures`

FIXTUREID	FIXTUREDATE	AWAYTEAM
8320	02-Jan-2017	CHEL
8321	23-Jan-2017	MANC
8322	18-Dec-2016	SUND
9767	15-Mar-2017	BORO
9770	16-Oct-2016	WATF
9889	05-Apr-2017	MANC

Table: `customer`

CUSTID	CUSTNAME	ADDRESS
10032	R. Sayers	Tess Ilkley Moor
17243	P. Smith	'Homeblest', Preston Capes
10035	V. Singh	23 Belle Vue St, Odiham
13420	P. Smith	Dove Cottage, Stratford

a) Write SQL statements that populate the fixture table with the first 2 rows of data.

(3 marks)

b) The `CREATE TABLE` statements are missing important constraints that could impact on the integrity of data in the tables.

(i) List **three types** of data integrity constraints that are absent in the script.

(3 marks)

(ii) Write three SQL `ALTER` statements (one for each type of data integrity constraint) that show how these data integrity constraints would be added to the script.

(9 marks)

c) Assume the script has been updated to include data integrity constraints. Why would an error occur if an attempt is made to run the script again? What extra SQL code is required to avoid this error occurring so that the script can run repeatedly?

(5 marks)

d) Write a query that counts the number of seats sold in each `seatingarea` for a fixture with `fixtureid = 8320`.

The query should return: -

SEATINGAREA	COUNT_OF_SEATS
West Stand	1
West Upper	1
South Stand	2
East Stand	1

(5 marks)

A3

a) A company uses the table below to record details of its projects. Each project is attached to a department and runs for a certain duration (in months). The primary key for this table is (`projnbr, deptnbr`):

PROJNBR	DEPTNBR	PROJNAME	DEPTNAME	DURATION
P01	D03	Web Portal	HR Dept	10
P01	D07	Web Portal	Sales Dept	10
P02	D07	Data warehouse	Sales Dept	7
P02	D03	Data warehouse	HR Dept	7

(i) Give an example of an "Update Anomaly" that may occur in this table. **(2 marks)**

(ii) Explain what is meant by "partial dependency" in a table. **(1 mark)**

(iii) Identify any partial dependencies in the above table. **(3 marks)**

(iv) Remove any partial dependencies from the above table by performing a normalisation process and show skeletal designs of the resultant tables. **(3 marks)**

b) The following table keeps record 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. Identify **three candidate keys** for this table.

PATIENTNBR	CONSULTATIONDATE	CONSULTATIONTIME	DOCTORNBR	ROOMNBR
P01	17-Aug-17	09:30	D01	R01
P01	20-Aug-17	14:00	D02	R02
P02	17-Aug-17	11:00	D01	R01
P03	17-Aug-17	11:00	D02	R02
P04	23-Aug-17	09:30	D01	R02

(8 marks)

c) The following table has attributes A, B, C and D:

A	B	C	D
a1	b1	c1	d1
a2	b1	c2	d1
a1	b2	c1	d1
a2	b2	c2	d1
a1	b3	c1	d2
a2	b3	c2	d2

(i) Explain what is meant by "**functional dependency**" in a table. **(2 marks)**

(ii) Identify **three** functional dependencies from the above table. **(6 marks)**

Section B
Answer Section B questions in Answer Book B

B4

Using your own simple examples and suitable diagrams, discuss the following Relational Algebra operators. For full marks, you must then supply an example SQL statement of how that concept is implemented.

a) PROJECTION **(5 marks)**
b) JOIN **(5 marks)**
c) INTERSECT **(5 marks)**
d) SELECTION **(5 marks)**
e) UNION **(5 marks)**

B5

Using your own simple examples and suitable diagrams, discuss the following data management concepts.

a) Database-level data validation and its implementation **(5 marks)**
b) User-interface data security and its implementation **(5 marks)**
c) Database-level redundancy, its problems and minimization **(5 marks)**
d) User-interface data validation and its implementation **(5 marks)**
e) Database-level data security and its implementation **(5 marks)**

B6

a) Database recovery is one of the main services provided by database management systems.
   (i) Describe five types of failure that may occur in a database environment. **(5 marks)**

   (ii) Discuss how the log file is a fundamental feature in any recovery mechanism by describing:
   - The contents of the log file
   - The write-ahead log protocol
   - How the log file is used in forward and backward recovery
   - How checkpoints affect the recovery protocol.

   (8 marks)

b) A Database can be defined as a self-describing collection of integrated records. Explain the meaning and the importance of the term “self-describing”.

(4 marks)

c) A company wants to move its current file-based system to a database system. In many ways, this can be seen as a good decision. Identify and describe four disadvantages in adopting a database approach.

(8 marks)