BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 5 Diploma in IT

DATABASE SYSTEMS

Tuesday 28th March 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

Study the following scenario then attempt the question parts that follow:-

Scenario AFC United

AFC United is a football club that host matches (also known as **Fixtures**) against an opposing team. A database is required by the club to hold information to support the booking of seats to watch a match at the club's stadium over the course of a season.

Prior to the start of a season a set of fixtures are arranged between AFC United (the home team) and an opposing team (the away team). Matches are watched by spectators who have registered with the club. These are called **PassHolders.** PassHolders must book seats in advance for any of the 20 home fixtures that season.

Once a **Seat** is booked (and payment made), the Pass Holder is issued with one or more **Tickets**.

A particular seat can have restricted occupancy. This is recorded as the seating type.

A PassHolder can purchases one or more tickets for seats for each fixture.

Important attributes (highlighted in bold font)

TicketNo This uniquely identifies which seat has been purchased on a particular date (the **Purchase Date**) by a particular Passholder for attending a particular fixture.

FixtureID This attribute uniquely identifies a particular football match that is played on a particular date (the **Fixture date**) between the home team and an opponent (called the away team). All games are played at the same stadium - the home ground of ABC United.

AwayTeam a unique 4 character code identifies the Team. Examples are CHEL,MANC,SUND,BORO

SeatID uniquely identifies a seat. Examples MM59,H105

SeatingArea is a seating area within the stadium. There are five distinct seating areas called North, South, East, West and Upper West Stands.

SeatType: Over the course of a season a fixed number of seats have restricted and exclusive occupancy. A restricted seat is recorded as one of four seat types Family; Reserved; Disabled; Away Supporters.

PassHolderID identifies a particular Pass Holder of AFC United, a person who has registered prior to purchasing seats. Passholder details such as **name** and contact details (**PHAddress**, **PhoneNumber**) are recorded.

a) Derive an Entity Relationship data model for the scenario above showing :-

The entity Types **PassHolders**, **Fixtures**, **Seats** and **Tickets** and the Relationships between them.

Relationship constraints:
For each relationship show the degree (1:Many;many :many or 1:1) and participation (mandatory or optional).

Attributes assigned to entity types using the listed attributes shown above in bold font. Underline the primary key attributes

You may choose any modelling notation but ***you must state*** the notation you have used. State any necessary assumptions you make, on the understanding they do not contradict the scenario.

(11 marks)

b) Design a set of Tables, derived from your ERD and illustrate them with a **small amount** of sample data. That is, data that represents all of the degrees of the relationships.

Note: You are not required to include data types or check constraints, but you must specify all columns and state which are primary/foreign keys.

(6 marks)

Table `tickets`

TICKETNO	**PURCHASEDATE**	***PASSID***	***FIXTUREID***	***SEATID***
107823	*13-Dec-2016*	*10032*	*8320*	*MM59*
959235	*13-Dec-2016*	*10032*	*8321*	*H105*
736228	*15-Oct-2016*	*3420*	*9770*	*K4*
107922	*15-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*

Table `passholder`

PASSID	**NAME**	**ADDRESS**
10032	*R.Sayers*	*'Tess' Ilkley Moor*
7243	*P.Smith*	*'Homeblest', Preston Capes*
10035	*V.Singh*	*23 Belle Vue St, Odiham*
3420	*P.Smith*	*Dove Cottage, Stratford*

Table: seats

SEATID	SEATINGAREA	SEATTYPE
C11	West Stand	Reserved
MM59	West Upper	
H105	South Stand	Family
H106	South Stand	Family
G3	East Stand	Away
K4	North Stand	Disabled

c) Show with the aid of a diagram how the data in your tables is related to support the data access requirements of the following query:-

List the names of the passholders who have purchased tickets with Seat type = "Family" for a particular fixture?

(3 marks)

d) Explain briefly what is meant by a Weak Entity Type. Provide an example of a Weak EntityType either from the scenario or using an example of your own.

(5 marks)

A2

Refer to the tables Figures A2.1 and A2.2 below for this question.

Fig A2.1 transactions Table

TRANSACTIONID	ACCOUNT_ID	TRANSACTION_DATE	AMOUNT
7659897	93008	12/4/2017	3.67
7659898	93008	12/4/2017	12.99
7743433	93008	13/4/2017	-7.99
7935320	331449	13/4/2017	-14.76
8756571	93008	13/4/2017	-5.99

Fig A2.2 accounts Table

ACCOUNT_ID	SORT_CODE	ACCOUNT_TYPE	BALANCE
93008	30-54-87	Direct Debit	362.74
331449	31-12-54	Credit	320.26
57746	30-54-87	On-Line Saver	1295.60
16227	12-32-18	Direct Debit	-550.93

a) List the results of running both the following queries (Query A and Query B) and then describe in a few sentences how these results are produced.

(8 marks)

Query A:

```
SELECT COUNT(*), account_type
FROM accounts
WHERE balance < 4000
GROUP BY account_type
HAVING COUNT(*) > 1;
```

Query B:

```
SELECT SUM(AMOUNT), t.account_id, transaction_date
FROM transactions t
WHERE t.account_id IN (SELECT a.account_id
                       FROM accounts a
                       WHERE account_type <> 'On-Line Saver')
GROUP BY t.account_id, transaction_date
ORDER BY SUM(amount) ASC;
```

b) Write an SQL query that produces the same output as query B, but instead uses an INNER JOIN operator.
For guidance, the syntax of an `INNER JOIN` operator is:-

`INNER JOIN <tablea name> ON <tablea.columna> = <tableb.columna>`
where `columna` is the matching column in `tablea` and `tableb`

(5 marks)

c) Explain the differences between LEFT and RIGHT OUTER JOIN and an INNER JOIN. Illustrate your answer by showing how replacing an INNER JOIN operator with either a LEFT or RIGHT OUTER JOIN operator can affect the output your answer in part b) above.

Hint : You must choose between either a RIGHT or LEFT OUTER JOIN to illustrate the different output produced compared with using an INNER JOIN

(6 marks)

d) Write an SQL `UPDATE` statement that updates the running total of the balance for account_ID 93008 for transactions made on this account on 13-APR-2017. Following this update the new balance for this account should be 348.76

(6 marks)

A3

a) A company places orders for items. Each order is placed on a given date, and may include a variety of items in different quantities. The following table shows a sample of orders. The Primary Key is (`OrderNo`, `ItemNo`).

orders

ORDERNO	ITEMNO	ITEMDESCRIPTION	DATE	QUANTITY
1	1	Screw	Jan 6th	100
1	2	Bolt	Jan 6th	50
2	3	Flange	Feb 2nd	10
2	2	Bolt	Feb 2nd	40
2	1	Screw	Feb 2nd	80

(i) Explain why this table is not in 2nd normal form. **(2 marks)**

(ii) Describe two types of anomaly that could be caused by update, insert or delete operations giving an example of each, with reference to the above table.

(4 marks)

(iii) Transform the table into 2nd normal form. Show the structures of the resultant tables. **(4 marks)**

b) A company wants to create a database to store records of its employees. For each employee, we record their personal details, the location of the branch where they work and their qualifications. Below is a sample of data for two employees.

EmployeeID: E001	**Name:** Fred Gordon	**JobTitle:** Web Developer	
BranchCode: B04		**BranchAddress:** Delhi	
QualificationID	**Qualification**	**Level**	**Year Obtained**
1	BSc	Undergraduate	2012
3	PhD	Postgraduate	2016

EmployeeID: E002	**Name:** Simon Singh	**JobTitle:** IT Manager	
BranchCode: B01		**BranchAddress:** London	
QualificationID	**Description**	**Level**	**YearObtained**
1	BSc	Undergraduate	2009
2	MSc	Postgraduate	2010

The un-normalised table that corresponds to the above format is as follows:
Employee(**EmployeeID**, Name, JobTitle, BranchCode, BranchName, QualificationID, Description, Level, YearObtained)

i) Identify the repeating group of attributes and transform the above un-normalised table into tables that are in 1st Normal Form. **(5 marks)**

ii) Identify any partial dependencies and transform into tables that are in 2nd Normal Form. **(5 marks)**

III) Identify any transitive dependencies and transform into tables that are in 3rd Normal Form. **(5 marks)**

Section B
Answer Section B questions in Answer Book B

B4

Using the following sample relation and your knowledge of declarative constraints :

STUDENT (Title, Name, Gender, Birthday, Address, Email, Mobile, SID, MID, PROJID, PLACID)

- *SID is the student identifier*
- *MID is the identifier of the compulsory assigned staff mentor*
- *PROJID is the identifier of the optional project selected by the student*
- *PLACID is the identifier of the optional industrial placement undertaken by the student*

Address each of the following tasks.

a) Suggest and justify a PRIMARY KEY for this relation.
Write the correct SQL code to implement this. **(5 marks)**

b) Suggest and justify any FOREIGN KEYS for this relation.
Write the correct SQL code to implement this. **(5 marks)**

c) Suggest and justify all CANDIDATE KEYS for this relation.
Write the correct SQL code to implement this. **(5 marks)**

d) Suggest and justify one DOMAIN constraint that enforces the entering of a value in a column.
Write the correct SQL code to implement this. **(5 marks)**

e) Suggest and justify one DOMAIN constraint that verifies the entered value in a column.
Write the correct SQL code to implement this. **(5 marks)**

B5

For each of the following types of database interface or access mechanism, explain their key features, strengths and weaknesses, plus the typical type of user situation where that interface would be best utilized.

a) A command line terminal. **(5 marks)**

b) A database utility. **(5 marks)**

c) A graphical user interface comprising forms and reports. **(5 marks)**

d) An SQL script. **(5 marks)**

e) A webpage. **(5 marks)**

B6

a) Explain the concepts of **transaction scheduling** and **serialisability**, Describe one type of problem (giving an example) that might appear when a transaction schedule is not serializable. **(8 marks)**

b) Modern database systems provide a mechanism for enforcing a password policy that has the following features:

- Complexity
- Failed attempts
- Expired passwords
- Password reuse

Describe each of the above features and explain how they help protect the database. **(8 marks)**

c) Backups of the database should be taken in order to protect data. Describe five features of a good backup strategy. **(5 marks)**

d) Describe the role, and content, of the data dictionary (metadata) in a DBMS. **(4 marks)**