BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 5 Diploma in IT

DATABASE SYSTEMS

Thursday 29th September 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 **NOT** allowed in this examination.

SECTION A
Answer Section A questions in Answer Book A

A1

a) One of the main responsibilities of a database developer is to enforce the following integrity constraints on database tables :-

Domain Integrity

Entity Integrity

Referential Integrity

i) Write SQL code to show how you would implement *EACH* of these constraints on the Tables provided in Figures A1.1 to A1.3 below.

(12 marks)

ii) Write TWO SQL statements, one an INSERT, the other a DELETE statement, that will test whether your referential integrity constraints are actioned.

(4 marks)

b) One of the main responsibilities of a DBA (database administrator) is to enforce security measures on user access to database data.
Describe these security measures and provide examples, written in SQL, of their construction, using the sample tables provided.

(9 marks)

Apply your example SQL code to the tables given in Fig A1.1 Fig A1.2 and Fig A1.3 below.

Fig A1.1 HOTEL Table

HOTEL_CODE	HOTEL	RESORT
FLB	Flamingo	Benidorm
BHB	Bali Hai	Benidorm
HAZ	Hawaii	Santa Posa
SPZ	Sun Park	Playa Blanca
AHB	Al Hambra	Benidorm
JDM	Jardin del Sol	Palma Nova
SPB	Sun Park	Playa Blanca

Fig A1.2 HOTEL_PACKAGE Table

HOTEL_CODE	PACKAGE_ID	PRICE
FLB	1	265
JDM	1	295
BHB	3	199
HAZ	4	308
SPZ	6	310
AHB	2	199
JDM	3	199
JDM	6	169
SPB	6	159

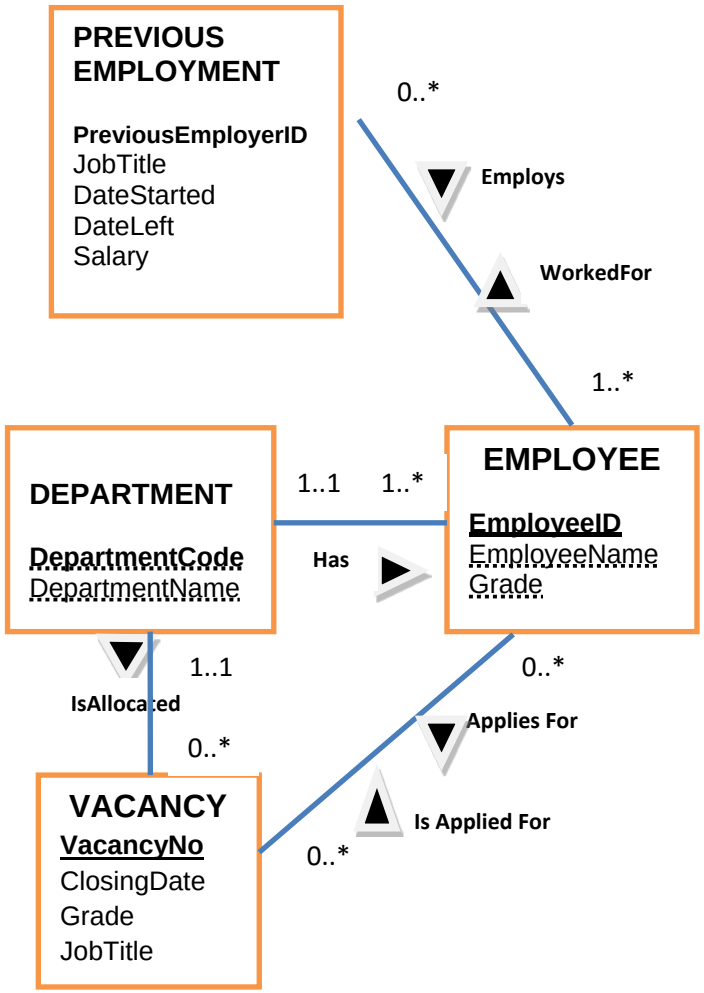
Fig A1.3 PACKAGE Table

PACKAGE_ID	CATERING	NIGHTS	MONTH
1	SC	7	June
3	FB	14	November
4	HB	10	July
6	FB	10	November
2	HB	14	May

A2

Refer to Fig A2.1 below. This is an Entity relationship (ER) data model presented in UML notation that is intended to be used in the design of a Human Resources (HR) database for a Company.

Figure A 2.1 HR data model for use in question 2



a) Explain the benefits of using ER data modelling techniques to assist in the design of a relational database.

(6 marks)

b) Identify the THREE types of data modelling constructs used in the ER data model given in Fig A2.1 and state how they influence the design of relational database tables.

(6 marks)

c) The data model given in Fig A2.1 has omitted a key step in logical database design. The omission of this step means that logical entities cannot be directly mapped to physical tables.
Explain what key step is missing and give ONE example that shows how you would update the data model given in Fig A2.1 to resolve this omission.

(6 marks)

d) Explain how you would extend the data model given in Fig A2.1 to represent the following requirement.

*Candidates who apply for a vacancy that a department wants to fill are employees of the company. A vacancy is normally filled following one or more **interviews**. In an interview each candidate (the interviewee) is interviewed by another employee (the interviewer). Following an interview a vacancy may or may not be filled. If it is a successful candidate is appointed to a new **position** within the company. Unsuccessful candidates continue in their current **position**.*

*The database needs to record information about the interviews conducted for a particular vacancy. Who is interviewed, by whom and the outcome (offer of a position or a rejection). The new **position** that an employee is appointed to must also be recorded. This includes the unique Position Number, the Job Title, the salary and the start date.*

Please Note: You must state any assumptions you made and make sure you adhere to a standard modelling notation.

(7 marks)

A3

a) A business keeps invoices in the format shown below:

customerID: C12 **custName:** John Silver **custAddress:** 47 High Street, London			
productCode	**prodName**	**Price**	**Quantity**
P1	Laptop	£300	2
P2	iPad	£250	3

(i) Identify the repeating group of attributes and transform the above format into tables that are in 1st Normal Form.

(4 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.

(2 marks)

b) An embassy records details of interviews of visa applicants in the table below.

Interviews are conducted by members of staff in some of the embassy rooms.
In any given day, a member of staff tends to use the same room throughout that day.
An applicant cannot have two interviews in the same day.

applicantNo	interviewDate	interviewTime	staffNo	roomNo
AP1	13-May-2016	10:30	S5	R101
AP2	13-May-2016	12:00	S5	R101
AP3	13-May-2016	12:00	S9	R200
AP2	22-Sep-2016	10:30	S5	R200

(i) Explain the term *candidate key*.

(2 marks)

(ii) List **three** candidate keys for the above.

(6 marks)

c) The following table stores details of doctors, patients and dates of appointments. The Primary Key is (doctorID, patientID).

Appointments

doctorID	**doctorName**	**patientID**	**patientName**	**date**
D01	Kumar	P02	Smith	10-Aug-16
D01	Kumar	P01	Ford	5-Sep-16
D02	Robinson	P02	Smith	10-Aug-16

(i) Explain why the above table is not in 2nd Normal Form.

(2 marks)

(ii) Transform the table into 2nd Normal Form tables.

(4 marks)

SECTION B
Answer Section B questions in Answer Book B

B4

a) Using your own simple examples and any diagrams you feel suitable, explain how the concept of *constraints* can be enforced within relational theory.

(10 marks)

b) Using your own simple examples and any diagrams you feel suitable, explain how the concept of *structure* can be demonstrated within relational theory. You should clearly illustrate the key terminology involved.

(15 marks)

B5

a) There are many ways in which a user can interface to a database. Using your own simple examples and any diagrams you feel suitable, describe the key features, strengths, weaknesses and typical uses & users of the following types of interface:

i) Text-based

(5 marks)

ii) Form-based

(5 marks)

iii) Web-based

(5 marks)

b) End-users have a tendency to make mistakes. While the database will (hopefully) have a wealth of data integrity constraints to prevent erroneous data getting into the database, it is desirable to stop such bad data ever getting to the back-end database in the first place.

Describe the *user-interface* components and techniques that appear on forms and websites that may be used to implement these data validation techniques. Why might it be preferable to catch invalid data at the interface level rather than at the database level?

(10 marks)

B6

a) The ANSI-SPARC architecture provides data independence.

(i) Describe the meaning and objective of data independence.

(2 marks)

(ii) Describe each of the three levels of the ANSI-SPARC architecture.

(6 marks)

b) Database Management Systems provide the following services:

- Concurrent Control
- Recovery
- Authentication
- Integrity

Briefly describe each of the above services and show how they can be achieved.

(8 marks)

c) The three-tier architecture is commonly used to implement a database driven web application.

(i) Draw a diagram to illustrate this architecture.

(3 marks)

(ii) Describe the role of each tier.

(3 marks)

(iii) Discuss three advantages of this architecture.

(3 marks)