

# BCS THE CHARTERED INSTITUTE FOR IT

## BCS HIGHER EDUCATION QUALIFICATIONS BCS Level 5 Diploma in IT

### DATABASE SYSTEMS

Thursday 21<sup>st</sup> April 2011 - 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. Consider the following scenario:

“A small Bank has two branches, one in Bristol and one in Bath, and has its head-quarters in London. Currently, it has a centralised database in its headquarters where it keeps data about its customers. Locals use consists of report generation for trend analysis. On the other hand applications at the two branches access this database via a communication network for whatever data they need. There is also a communication link between the two branches, which is currently used only when one of the main links to the London headquarters fails.

The only relation in this centralized database system is the Customer relation, where data about customer accounts are kept. The attributes of the Customer relation are, the account number (Acc\_no), the customer's name (Cust\_name), the branch where the account is kept (Branch) and its current balance (Balance). An instance of the Customer relation follows:

**Customer relation**

Acc_no	Cust_name	Branch	Balance
200	Jones	Bath	1000
324	Smith	Bristol	250
153	Gray	Bristol	38
426	Dorman	Bath	796
500	Green	Bristol	168
683	Roy	Bath	1500
252	Elmore	Bath	330

Due to heavy network traffic the bank's service to its customers is poor. The Bank is concerned and has asked you to investigate database distribution designs that will improve its service.”

Propose three distribution designs one for each of the following requirements. Also justify each proposal and outline its advantages and disadvantages.

**Turn over]**

- i) The database should always be available to all sites and access to it should be fast even in the case of data communication link failures.  
(7 marks)
- ii) There should be no redundancy in the allocation of data, i.e. only local data should be stored at a site.  
(10 marks)
- iii) A reasonable compromise between requirements (i) and (ii). And also justify each proposal and outline its advantages and disadvantages.  
(8 marks)

*Note: There are a number of reasonable proposals that would satisfy the above requirements, especially for requirement (iii). You will be assessed on how well you argue your proposals, and not on whether you come up with a particular one.*

- A2. a) What is normalisation?  
(5 marks)
- b) Use the following form to complete first, second and third normal forms:  
(10 marks)

PONo	SupCode	SupName	SupAdd	DelDate	Partno	Desc	Qty	Unit	Price
P001	S123	Windwin	York	3/2/11	PT104	Door	5	1	80.00
					PT105	Bolt	10	10	2.00
P002	S456	Flyaway	Manchester	3/2/01	PT105	Hinge	20	10	5.00
<b>Etc.</b>									

The attributes used in the form are:

**PONo** stands for purchase order number  
**SupCode** stands for supply code  
**SupName** stands for supplier name  
**SupAdd** stands for supplier address  
**DelDate** stands for delivery date  
**Partno** stands for part number  
**Desc** stands for product description  
**Qty** stands for quantity  
**Unit** stands for unit per part package  
**Price** stands for price of the part(s)

- c) Use completed third normal form to generate database model with correct relationship between entities.  
(10 marks)

## Section B

Answer Section B questions in Answer Book B

B3. Read the discourse below and then use the information given in the discourse to expand your answers to the following questions.

- a) What is database modelling? Briefly describe its relevance in developing a database system. (5 marks)
- b) Explain entity types and Key attributes in a data model. (10 marks)
- c) What are constraints on relationships of a data model? (10 marks)

### Discourse

The National Swimming Federation (NSF) is responsible for organising swimming events for elite swimmers. So for example there will be many events but each event is uniquely identified by the venue (the place it takes place) and the date. An event consists of many competitions such as Men 50m freestyle; Women 100m backstroke.

Swimmers (also known as competitors) are selected for events by their home swimming club if they have achieved the qualifying time set by the NSF for different levels.

A competition is made up of 'rounds' and 'heats'. A 'heat' is a race between 8 competitors of which only the winner and runner up progress to the next round. A 'round' is a set of heats. For example if there are 64 competitors in a competition, with a first round with 8 heats.

The 16 heat winners and runners-up progress to the next round and so on until there is a semi-final round of 2 heats. The final round will be the winners and the best two times of the runners up of the semi-final heat.

The NSF has approved the development of a database system to support the processing of competition data for various events held.

The database system must enforce the following business rules:

B1: The home club who entered competitors for an event must be a current member of the NSF.

B2: The home club submit their highest ranked competitor(s) to a competition (with personal best times) and NSF then restrict entry to ensure a multiple of 64 entrants to a maximum 256 for each competition.

The current system uses a spreadsheet to record the results of each competition (heats and rounds) and highlights personal best times of competitors. Each worksheet represents a different competition for a particular event.

Turn over]

B4. Refer to Appendix A and the Ticket data (Figure A1).

- a) Express the ticket data given in Figure A1 as empty Tables (with only column names) using the information given in the discourse. (Do not show any working such as Normalisation or SQL code)  
(5 marks)
- b) Using one or two of the Tables you produced above in part a), write an SQL script (a logical sequence of SQL code) to implement EACH of the following tasks:-
  - i) Create the Tables each with a couple of columns including the primary key.  
(3 marks)
  - ii) Add columns to an existing Table.  
(5 marks)
  - iii) Add foreign key to an existing Table.  
(6 marks)
- c) Write an SQL script that populates a couple of rows for the Table you defined in part a) above.  
(6 marks)

B5. The following tables (with row counts) belong to a large Alternative Healing Clinic.

<b>Therapist</b> (therapistID,therapistName, therapistPostCode, ..... )	<b>100 rows</b>
<b>Treatments</b> (treatmentID, treatmentName,HourlyFee)	<b>209 rows</b>
<b>TreatmentOfferedBy</b> (treatmentId,therapistID)	<b>450 rows</b>
<b>Appointments</b> (appointmentID,therapistID,patientID,AppointmentDateTime)	<b>250000 rows</b>
<b>Patients</b> (patientID, patientFirstName, patientSurname, patientPostCode)	<b>50000 rows</b>

These tables are stored on a database server that supports web based client server architecture. Patients make appointments to see a therapist who treats a patients' ailment/illness by using alternative therapy (for example acupuncture).

- a) Write an SQL statement that lists which treatments are offered by which therapists. The resulting table should contain 2 columns - the names of the treatments and a concatenation of the first and surnames of the therapist.  
(3 marks)
- b) Write an SQL statement that lists the details of appointments for treatment by "acupuncture" with a patient named Myfawy (firstname) Jones (surname) with a post code containing the string "TS1". The resulting table should contain 4 columns- patient Surname, postcode, appointment date and appointment time  
(5 marks)
- c) Explain how you would extend the above query to include a count of the number of appointments satisfying the above query but instead for postcodes that match the string "TS".  
(4 marks)
- d) What indexes would you need to improve the performance of the queries you wrote in a) and b) above? Justify your answer.  
(6 marks)
- e) Explain, with reference to a DBMS of your choice, how you would measure the performance of the indexes you provided in part d above.  
(7 marks)

- B6. Refer to the discourse in Appendix A. Assume that at peak times the database server processes as many as 10 bookings made by different customers for seats at the same time.
- a) What is the purpose of 'concurrency control' in a database system? Give examples of the concurrency control measures that would be required in the theatre booking application.  
**(8 marks)**
  - b) What is meant by the terms READ COMMITTED and SERIALIZABLE in concurrency control?  
**(8 marks)**
  - c) Suppose you were required to develop the 'registering customers as members of the Theatre' part of the Theatre bookings application. Explain the techniques needed to guarantee security of the data and the confidentiality of customer data.  
**(9 marks)**

## APPENDIX A: Theatre Booking Database

**Discourse:** The following data represents a snapshot of ticket data generated from a theatre bookings database. This database holds bookings made by customers for seats at a performance of a particular production taking place at a particular theatre. Bookings are made over the WWW by registered customers who have agreed for certain personal details (such as name, age and address) to be held in return for priority booking and information of forthcoming productions.

Customers can either reserve a seat or pay for a seat in full at the time of booking. Reservations must be fully paid (and hence confirmed) within 7 days of the booking if the performance is more than 14 days ahead. Following a successful booking a 'printable' ticket is generated for the customer to print off and present at the theatre when they attend the performance or if they request a refund.

Seats are organised into areas with the most expensive in the circle with individual seats identified by a seat number (eg H3) and given a seat code, such as Reserved for sponsors (code R) ; reserved for Disabled customers (code D) otherwise the seat code is NULL. Seats are also given a seat status where 'C' indicates a booking for a seat has been confirmed and paid for otherwise the seat status is NULL if the seat is reserved.

When a performances is cancelled and customers are refunded the cost of their tickets in full subject to the customer producing a printed ticket (this acts as a proof of purchase). Alternatively customers can re-book for another performance of the same production on a different date. They must re-book or request a refund within 14 days after the date of the performance.

**Fig A1 Printed Theatre Tickets**

=====	=====	=====Receipt=====
=====	=	=====
TICKET NO <b>079231</b>	ISSUE DATE <b>13-Dec-2010</b>	TICKET NO <b>079231</b>
THEATRE <b>Welldon</b>	SEAT AREA <b>upper stalls</b>	
CUSTOMER <b>P. Smith</b>	SEAT <b>H3</b>	CUSTOMER No <b>10032</b>
CUST-ADDRESS <b>Dove Cottage</b>	PRICE <b>£5.75</b>	
<b>Stratford</b>	SEAT CODE <b>RC</b>	
PRODUCTION TITLE <b>12<sup>th</sup> Night</b>	PRODUCTION COMPANY <b>R.S.C.</b>	
PERFORMANCE DATE/am <b>02-Jan 2011 M</b>	SPONSOR <b>Teesside Polymers</b>	PERF_NO <b>8320</b>
=====	=====	=====Receipt=====
=====	=	=====
TICKET NO <b>309232</b>	ISSUE DATE <b>13-Dec-2010</b>	TICKET NO <b>309232</b>
THEATRE <b>Welldon</b>	SEAT AREA <b>upper stalls</b>	
CUSTOMER <b>P. Smith</b>	SEAT <b>H4</b>	CUSTOMER No <b>10032</b>
CUST-ADDRESS <b>Dove Cottage</b>	PRICE <b>£12.75</b>	
<b>Stratford</b>	SEAT CODE <b>C</b>	
PRODUCTION TITLE <b>12<sup>th</sup> Night</b>	PRODUCTION COMPANY <b>R.S.C.</b>	
PERFORMANCE DATE/am <b>02-Jan 2011 M</b>	SPONSOR <b>Teesside Polymers</b>	PERF_NO <b>8320</b>
=====	=====	=====Receipt=====
=====	=	=====
TICKET NO <b>309998</b>	ISSUE DATE <b>15-Dec-2010</b>	TICKET NO <b>309998</b>
THEATRE <b>Byron</b>	SEAT AREA <b>upper stalls</b>	
CUSTOMER <b>R. Sayers</b>	SEAT <b>MM3</b>	CUSTOMER No <b>3424</b>
CUST-ADDRESS <b>'Tess' Ilkley Moor</b>	PRICE <b>£13.75</b>	
	SEAT CODE <b>DC</b>	
PRODUCTION TITLE <b>Chopped Carrot</b>	PRODUCTION COMPANY <b>ShawTaylor</b>	
PERFORMANCE DATE/am <b>02-Jan 2011 M</b>	SPONSOR <b>The Vegan Society</b>	PERF_NO <b>869321</b>
=====	=====	=====
=====	=	=====
=====	=====	=====Receipt=====
=====	=	=====

TICKET NO **306298**  
THEATRE **Welldon**  
CUSTOMER **P. Smith**  
CUST-ADDRESS **'Homeblest',**  
**Preston Capes**  
PRODUCTION TITLE **12<sup>th</sup> Night**

PERFORMANCE DATE/am **20-Jan**  
**2011 P**

=====

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TICKET NO **079232**  
THEATRE **Welldon**  
CUSTOMER **V. Singh**  
CUST-ADD **23 Belle Vue St, Odiham**

PRODUCTION TITLE **12<sup>th</sup> Night**

PERFORMANCE DATE/TIME **02-Jan**  
**2011 M**

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ISSUE DATE **13-Dec-2010**  
SEAT AREA **circle**  
SEAT **MM3**  
PRICE **£5.75**  
SEAT CODE **C**  
PRODUCTION COMPANY  
**ShawTaylor**

SPONSOR **Gardeners World**

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ISSUE DATE **13-Dec-2010**  
SEAT AREA **upper stalls**  
SEAT **H5**  
AMOUNT PAID **£5.75**

SEAT CODE **C**  
PRODUCTION COMPANY  
**R.S.C.**

SPONSOR **Teesside Polymers**

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TICKET NO **306298**

CUSTOMER No **7243**

PERF\_NO **9770**

=====Receipt=====

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TICKET NO **079232**

CUSTOMER No **10035**

PERF\_NO **8320**

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**\*\* END OF EXAM \*\***