

**THE BCS PROFESSIONAL EXAMINATION  
Certificate**

**April 2002**

**EXAMINERS' REPORT**

**Information Systems**

**QUESTION ONE**

1. A *Theatre Agency* supplies tickets to shows at several theatres and cinemas in an area. Their clients can be individuals or groups of people from clubs and societies. Discounts are provided for groups over 10. Regular clients are given discounts if they book more than 6 performances per year. The company advertises in local and national papers, on local radio and on the web. Bookings can be made either by visits to the office, by telephone or on the web. Payment is made by cash, credit card or cheque. Regular clients, whether individual or group, are given one month's credit so details of their accounts need to be kept to ensure payment is made on time.
- a) You are employed by a local software company to provide small business solutions. Describe the stages, tasks and techniques you would use to analyse the above scenario and design a computerised solution. (12 marks)
- b) Using the above as examples, draft a series of data flow diagrams depicting the physical flow of data and its processes. Provide a key of the symbols you use within these diagrams. (9 marks)
- c) Identify the important entities, named relationships between them and example attributes for each entity. Indicate probable primary and foreign keys. (9 marks)

**Answer Pointers**

A description of possible methods of analysis and design and examples of the techniques used to analyse and design a computerised system are expected. A typical life cycle method needs to be described.

Processes: Maintain clients/club/society, maintain theatre/cinema venues, make a booking, calculate discounts, deal with payments, update accounts, produce adverts, pay advertisers

Entities: Client, Club/Society, Media, Theatre, Cinema, Performance, Booking, Payment, Account. Arcs could be used as a client is either a client or a club/society (not both), and bookings can be made at either a theatre or a cinema. Optionality could also be introduced.

**QUESTION TWO**

2. a) Compare and contrast the facilities offered by the following software tools, using examples with which you are familiar:
- i) CASE tools and Project Management Software (5 marks)

- ii) Expert Systems and Management Information Systems (5 marks)**
- iii) A Data Dictionary and a Database (5 marks)**

**b) Describe and give examples of the theory and concept of the following:**

- i) An object (5 marks)**
- ii) A class (5 marks)**
- iii) A method (5 marks)**

### Answer Pointers

CASE tool – computer aided software engineering tool is used to document and support the development process. They usually adopt a particular methodology such as SSDAM or YSM. Assistance is given with diagrams depicting logical and physical models, process and information flows. Often prototypes can be produced quickly and efficiently provided the design methodology has been followed.

Project management tools – provide support for the project in terms of phases, tasks, sub tasks, time, resources etc. e.g. Visual Project, MS Project

Expert Systems are systems which purport to contain expert knowledge and be able to apply that knowledge.

Management Information Systems assist the management by providing structured and analytical information as well as the facility to forecast and produce 'what if?' solutions.

Strictly these days, database management systems provide both support for the dictionary as well as the database. However they do exist as separate pieces of software, one describing the data (meta data) and the other containing and manipulating that data.

An object is anything that can be named and can contain both data and methods; e.g. a book which has an ISBN number, title, author etc and can be 'borrowed', 'bought' or 'lent' etc

A class is an abstraction of a set of objects that specifies a common state and behaviour. A subclass can inherit characteristics of its superclass; e.g. Mammal is the class, dog is subclass

A method is a procedure or function which an object can perform e.g. borrowing a book

### QUESTION THREE

- 3. a) You have been asked to supervise a trainee analyst to help produce a feasibility study. What is a feasibility study? What should it contain? What fact-finding techniques can be used? (15 marks)**
- b) Give two examples of costing methods that can be used to show that savings can be made by implementing a system. (6 marks)**
- b) Briefly describe the roles of:**
  - i) a Database Administrator (DBA) (3 marks)**
  - ii) a Network Administrator (3 marks)**
  - iii) a Systems Analyst (3 marks)**

### Answer Pointers

Technical, economic, social, operational aspects.  
Interviews, questionnaires, sampling, observation, etc.

Break even costing, Net present value, discount cash flow, etc.

DBA – responsible for the management of a database management system, control, security, maintenance, efficiency, optimisation, performance etc  
Network administrator – managing the network, its topology, control of traffic, physical implementation, telecommunication, etc.

Systems Analyst – analysis and design of a system under investigation, production of feasibility report, requirements specification, design, systems testing, physical implementation, take-on, review and maintenance, etc.

#### QUESTION FOUR

4. a) **The manager of a book and CD/record shop wishes to expand her business onto the Internet. She has heard the term ‘E-Business’ and ‘E-Commerce’.**  
**Draft a memo explaining these terms and give her advice on how the Internet could be used to increase her business and provide a competitive advantage.**  
**(6 marks)**
- b) **What techniques would you use to design a user-friendly web site?**  
**(8 marks)**
- c) **Draft two story boards/screens that you could use to show the effectiveness of a web site.**  
**(8 marks)**
- d) **What security issues would you advise her to take?**  
**(8 marks)**

#### Answer Pointers

As it is a business and commerce is mentioned then the candidate is expected to provide a way of carrying out the business on the web. Dealing with orders, enquiries, payments etc. They would also have to cover the advertising aspects. As records are mentioned, inclusion of multimedia (visual, aural) could be included.

HCI aspects – radio buttons, drop down lists, clear text, use of colour, etc.

Security – firewalls, usernames, passwords, levels of access, Etc.

#### QUESTION FIVE

5. **Explain the differences between each pair of terms given in the table (Figure 1) below:**

| Pair   | Relational Database Term | Computer Programming Term |
|--------|--------------------------|---------------------------|
| Pair 1 | Domain                   | Program Variable          |
| Pair 2 | Relation                 | Data File                 |
| Pair 3 | Recordset                | Record                    |
| Pair 4 | Stored Procedure         | Procedure                 |

## Figure 1: Pairs of terms

(12 marks)

Most candidates could provide fairly good knowledge of individual terms but many candidates could not clearly indicate the major differences. In fact some candidates did not seem to realise that the terms were related. Thus some misconceptions on terms such as Relation (not a relationship) and Domain (not a web site domain) were apparent. Many candidates did not see any difference between the terms for Pair 4 where the uniqueness of stored procedures was expected.

### Answer Pointers

Pair1: Domain is a column in a Relation which can only be processed by implicit Relational operators whereas a Variable is manipulated by a program statement and does not contain any constraints such as those found with domains (e.g. to check/integrity constraints)

Pair2: Relation is a logical object which visualises and manipulates persistent data as a two dimensional Table. Data File is any PHYSICAL persistent data storage mechanism whose structure is defined by a programming language or markup such as XML. Note Data Files in databases are abstracted away from the user/programmer and only visible to DBAs for backup/recovery.

Pair3: Recordset is a specific programmable entity representing a cached data set which acts as a cursor (or record pointer) to a row in a table. A record again is more general and refers to any persistently held data object in flat or non-regular data sets held on physical devices.

Pair4: Stored procedures are unique to server-side databases (e.g. Oracle, Ingres) and contain embedded processing logic associated with a particular database object. They are usually written in extended SQL (e.g. PSQL/TransactSQL). In contrast, procedures are general programming terms associated with algorithms and within the scope of a computer program.

### QUESTION SIX

6. Write short notes on **THREE** of the following technologies explaining how they are used in the development of a distributed information system.

- i) **Active X control**
- ii) **FTP server**
- iii) **CGI script**
- iv) **Active Server Page**
- v) **HTML form**

Indicate whether the technology runs on the client, on the server, or on both.

(12 marks)

These technologies are now common place in most web-based information systems and candidates should be increasingly aware of the rapid changes that are being made. It was apparent that many candidates answers were shrouded with jargon; in fact these terms have a specific meaning in the technology of web-based information systems.

### Answer Pointers

ActiveX control is a component that is usually downloaded over the internet usually to enhance the functionality of a web application. The component (similar to a Java Applet) then runs on the client PC and runs within the browser.

FTP server has local software that provides a window to transfer files from a web server to the local client computer. The web server is accessed by internet protocols and connected through the IP address. Thus the technology requires both client and server side technology to exchange files.

CGI script is a program that runs on the server side. It is necessary to respond to a request for a web page/resource from a client PC connected to the internet. The CGI script is executed and processes some results (maybe to access a database) and generates HTML back to the client. CGI scripts are written in many languages; the most popular language is Perl because of its power.

Active Server Page (ASP) is similar to CGI but differs in the way the program is executed; i.e. CGI scripts create a separate call to the operating system. ASP runs in a common (Microsoft dependent) runtime environment.

A HTML form is the result of using a particular coding technique that renders Form objects within a browser. HTML encompasses this technique by providing special tags and controls and the ability to POST values entered on a Form to the next page.

**QUESTION SEVEN**

7. a) Assume the data in Figure 2 below represents a badly designed database table. Identify each of the following concepts:

- i) An attribute which is an identifier but is NOT the primary key
- ii) A 'One to Many' Relationship
- iii) A Null value (6 marks)

b) Explain why the presence of each of the above concepts in part a), indicates that Figure 2 represents a badly designed database table. (6 marks)

| Customer ID | OrderID | OrderDate | ItemID | ItemDescription | CustomerName |
|-------------|---------|-----------|--------|-----------------|--------------|
| 3           | 3       | 23-Dec-01 | 2      | 5cm Bolt        | CJ James     |
| 3           | 5       | 23-Jan-02 | 2      |                 | CJ James     |
| 5           | 6       | 23-Jan-02 | 2      |                 | MK Patel     |
| 5           | 6       | 23-Jan-02 | 4      | Washer          | MK Patel     |
| 5           | 7       | 24-Jan-02 | 4      |                 | MK Patel     |

**Figure 2: A Badly Designed Database Table**

For part a) candidates should list and then comment briefly on the justification of their answers. Even incorrect answers can attract marks if there are plausible assumptions. In part b) the question did NOT ask for a full working out of the normalised tables. This

part was generally poorly attempted and few marks were awarded in contrast to the first part of the question.

**Answer Pointers**

- i) CustomerID, OrderID, ItemID are all identifiers, none of these can be the primary key for the Table implying the existence of the problem typical of un-normalised relations; that is part-key dependencies (i.e. OrderID -> OrderDate but OrderID /=> ItemID). The primary key is in fact a composite of OrderID and CustomerID
- ii) OrderLine (orders->items). An order consists of many items (called an order line). A repetition is apparent in the Table reflecting the order line. Repeating groups cause data values to be duplicated non-redundantly; usually an additional field is used to make a row in a table unique. The combination of two or more fields forms a compound key.
- iii) ItemDescription contains various Null values. A Null Value is a reserved word which represents 'missing' or 'not applicable' values to be assigned to fields that contain no data. NULL values create ambiguity and may indicate the absence of a full functional dependency.

**QUESTION EIGHT**

8. A hotel company owns a chain of approximately 50 hotels throughout a country. Currently each hotel has its own booking system which records room bookings made by customers on a spreadsheet. Bookings are entered into a particular cell (see Figure 3) and contains the guest's name and an address code.

The Managing Director for the hotel company needs to be convinced that the current booking system, described above, is inefficient in terms of staff costs and information processing.

Draft a brief non-technical report to the Managing Director outlining the benefits that a web-based booking system could offer over the existing system.

| DATE     | Room no 1         | Room no 2        | Room no 3      | Room no 4     | ... | Room no 25        |
|----------|-------------------|------------------|----------------|---------------|-----|-------------------|
| 1/09/01  | Whittle, YO12 7DE |                  | Lyons, HU9 7GT | Piro, DL9 7HC |     | Goodison, HU9 8BD |
| 2/09/01  | Mann, HU1 6TY     | Mistry, NE3 9WS  | Lyons, HU9 7GT |               |     |                   |
| 3/09/01  | Petty, YO3 9HB    | Mistry, NE3 9WS  |                |               |     |                   |
| 4/09/01  | Petty, YO3 9HB    | Mistry, NE3 9WS  |                |               |     | Kuma, TS9 7TY     |
| .....    | .....             | .....            | .....          | .....         | ... | .....             |
| 30/09/01 |                   | Shandri, TS8 6YJ |                |               |     | ....              |

Figure 3: Example spreadsheet for bookings made for a hotel during September (12 marks)

A wide range of answers which covered some of the ground indicated below. However well balanced reports were rare and many reports were unconvincing and disjointed. Report writing was quite weak in general and negated a lot of good points that were often made.

### **Answer Pointers**

The report must be concise and address issues such as the cost effectiveness of increased automation (as less staff are required) and integration of data across hotels. Clearly guests can check availability and plan an itinerary without having to contact each hotel.

A web-based platform with server-side scripting is the main requirement though this should be obvious. It is more important that the candidates are aware of the major differences in the way the new system works and the opportunities it will open up. Thus a well balanced discussion should be produced to reflect this. For example a balanced report should:

- Allays fears that the MD has with regards to security and privacy of customer transactions made over the internet.
- Discuss the resource issues of having a central DBMS running on a server and application server support for this facility.

The information system must be able to respond to bookings entered by users and present accurate and up-to-date information on the status of bookings. A description of the main software components was NOT expected.

### **QUESTION NINE**

**9. Describe, with the aid of examples, the distinctive principles and the motivations behind THREE of the following diagramming techniques used in the design of an information system:**

- i)* **Rich Pictures**
- ii)* **Class Diagram**
- iii)* **Use Case model**
- iv)* **Semantic Net**

**(12 marks)**

Generally good presentations were those that provided illustrative examples of a system design from the candidates own experience. Few candidates were familiar with Semantic Nets and elected to answer the first three options.

### **Answer Pointers**

The diagramming techniques are quite new to information systems; candidates should be aware of emerging trends and realize the importance of alternative paradigms (such as Soft Systems Analysis and Object Orientation) to the structured systems approaches. In fact Object Oriented systems are becoming the mainstream of software development.

Rich Pictures are particular to Soft Systems methodology and used to assist end-users and designers focus on pictorial models of system processes and user models from the

end-users perspective covering organisation boundaries and motivations rather than technical detail.

Abstraction oriented data model diagrams using Object Oriented (OO) concepts of Class/Association and Method. Various OO notations exist to express semantics such as inheritance and aggregation.

UseCase : Similar to Rich Pictures but more rigorously focused on the context of processing logic within a users perspective (called a use-case scenario)

Semantic Net: A technique that draws facts and associations using binary relationships used to model instance level of a discourse

## QUESTION TEN

10. Design a user interface for the following scenario:

***A University has a music CD collection that is available for members to borrow. Existing University employees qualify as members, but they must register and pay an annual fee before they can become a member. Three members are designated as 'superusers'; they are responsible for the operation of an information system that supports the following tasks:***

- ***Organise and maintain a database that stores information about each CD held in the collection***
- ***Maintain a list of members and record their membership details such as name, email address and start date of membership***
- ***Process the Loan and Return of CDs***
- ***Send reminders by mail for overdue loans and when membership is due to expire.***

***Assume the following:***

- ***One of the 'superusers' has the role of 'librarian' and can issue loans and process returns***
- ***Members can borrow up to 3 CDs at any time***
- ***The period of a loan is 21 days, after this time the loan is recorded as being overdue***
- ***The information system is operated on a single-user basis using a PC workstation.***

**Your design should include:**

- **A diagram showing a menu structure for your user interface.**
- **A series of sketches showing the interaction between the librarian and your user interface.** (12 marks)

Mostly satisfactory answers. The main shortcomings which were apparent included:  
Getting bogged down with too much unnecessary detail  
Screen forms with little or no discernable functionality.  
Drafts of screen forms without any justification/rationale behind their designs.

## Answer Pointers



The user interface should avoid unnecessary input via typing in values, as this leads to errors and delays. Useful functions such as 'partial completion' or drop down lists should be used where appropriate. Excessive prompting should be avoided - rather user controls should be disabled/hidden to prevent the user getting out of step in the interaction.

Form based design is expected and common in data intensive/transaction based interfaces since the interface may be 'database aware' and actively interpret the user in filling in data directly or provide something similar to a Query By Forms interface.

Options:

Use Menu Line controls where menu options are presented in a command line followed by a function key which invokes the selection. Very effective and easy to use

## QUESTION ELEVEN

11. A college runs a number of courses that can be studied part-time. Students enrol on a course and can take an assessment at the end of a course. Given below are a series of transactions and constraints that relate to an application that stores enrolment and assessment data. The constraints are used to maintain the data integrity of the application. Assume there are three courses that run on different days over a period of 12 weeks. The courses have run in the past and this may be reflected or implied in the transactions.

- a) Express the transactions as a collection of records in a data file such that the data is consistent with the given constraints. Include any additional records necessary to maintain the data integrity of the application. Show your working out and state any assumptions you have made. (8 marks)
- c) Choose a constraint and outline how you would enforce the data validation required for that constraint. (4 marks)

### TRANSACTIONS :

- T1: Create a course identified by a unique code 'JDP'.
- T2: Enrol a student called John Brown to course 'JDP'
- T3: Enrol a student called Bob Wright to course 'EJB'
- T4: Enrol a student called John Brown to course 'JDP'
- T5: Enrol a student called John Brown to course 'JDB'
- T6: Assessment for John Brown awarded Grade = 'PASS'
- T7: Enrol a student called Alex Brown to course 'JDP'
- T8: Create a course identified by a unique code 'JDB'.
- T9: Create a course identified by a unique code 'JDP'.
- T10: Enrol a student called Joe Smith to course 'JDP'
- T11: Enrol a student called John King to course 'JDB'
- T12: Enrol a student called John Brown to course 'EJB'
- T13: Assessment for Alex Brown awarded Grade = 'PASS'
- T14: Assessment for John Brown awarded Grade = 'FAIL'

### CONSTRAINTS :

- C1: Three courses, identified by codes 'JDP', 'JDB' and 'EJB', are the only valid courses.
- C2: 'JDP' is the course that must be studied before studying either course 'JDB' or 'EJB'.
- C3: A student can enrol on no more than two courses at a time and can re-take a course at any time in the future if that course runs in the future.

**C4: At the end of each course an assessment grade (either ABSENT, PASS or FAIL) must be recorded for each student. A student who elects not to undertake an assessment is given the grade 'ABSENT'.**

A question that many candidates avoided! There were quite a few different interpretations which required a statement of assumptions. The examiner was expecting candidates to work through each transaction in a serial fashion, thus applying constraints without prior knowledge of future transactions in the list. The result should be a file of data containing successful transactions validated at run-time. Working out should be indicated thus (marks would be credited appropriately):

*Possible working of the outcome of each TRANSACTIONS one at a time:*

- T1: Create a course identified by a unique code 'JDP'. C1 OK: Action create a course record, JDP is a valid entry
- T2: Enroll a student called John Brown to course 'JDP' C1 OK, Action Create a new enrolment record.
- T3: Enroll a student called Bob Wright to course 'EJB' C1?, C2- check prerequisites cannot proceed
- T4: Enroll a student called John Brown to course 'JDP' C1 OK, C3 – check duplicated record, Assume different student.
- T5: Enroll a student called John Brown to course 'JDB' C1?, C2 – check pre-requisite, C4 previous studyJDP? result PASS?
- T6: Assessment for John Brown awarded Grade= 'PASS' T5 pending cannot proceed.
- T7: Enroll a student called Alex Brown to course 'JDP' C1 OK create a new enrolment
- T8: Create a course identified by a unique code 'JDB'. T5, T6 OK proceed with action add new records.
- T10: Enroll a student called Joe Smith to course 'JDP' C1 OK, create new enrolment record.
- T11: Enroll a student called John King to course 'JDB' same as T3
- T12: Enroll a student called John Brown to course 'EJB' C1? Cannot proceed, C2 OK pre-requisites OK
- T13: Assessment for Alex Brown awarded Grade= 'PASS' C4 OK
- T14: Assessment for John Brown awarded Grade= 'FAIL' Check which person called John Brown

## Answer Pointers

A set of records would only be added to a data file if the transactions can proceed, sometimes pending other constraints being met.

Candidates should work though each transaction, determine the outcome then list the data that has been created (i.e. new records in a file called enrolment).

A possible flat file showing the stored data as a result of successful transactions. A Key field (EnID) is used to identify enrolment records of each student with period/year.

| EnID | StID | StudentName | CID | Result | Period/Year                          |
|------|------|-------------|-----|--------|--------------------------------------|
| 1    | s1   | John Brown  | JDP | PASS   | 2000                                 |
| 2    | s1   | John Brown  | JDB | FAIL   | 2001                                 |
| 3    | s2   | John Brown  | JDP | ABSENT | 2001                                 |
|      |      |             |     |        | also applies to EnID=1 previous year |
| 4    | s3   | Alex Brown  | JDP | PASS   | 2001                                 |

|    |    |            |     |        |      |
|----|----|------------|-----|--------|------|
| 5  | s4 | John King  | JDB | ABSENT | 2001 |
| 6* | s5 | Bob Wright | JDP | PASS   | 2000 |
| 7  | s6 | Bob Wright | EJB | ABSENT | 2001 |
| 8  | s7 | Joe Smith  | JDP | ABSENT | 2001 |

Marks were awarded on the integrity of the resulting data file and the justification of the insert/delete/update.

- b) For example constraint C4 could be checked in the user interface by using correct dynamically generated drop down lists of valid courses.

## QUESTION TWELVE

12. Describe how the techniques known as **CONCURRENCY CONTROL** and **RECOVERY** work together to ensure that the integrity of the data is maintained in the following situation:

**The data held in an on-line order processing system may be subject to users issuing many transactions that require access to the same data item. For instance, when an item is purchased, the effect of the data processed by one person may cause the data read by another person to become inconsistent.**

**(12 marks)**

Most candidates could explain how the techniques of Concurrency and Recovery were implemented on their own, but few candidates could explain how techniques work together to ensure data integrity. Recalling notes on the A.C.I.D. acronym was also common but this was not the most relevant aspect of concurrency.

### Answer Pointers

Mention of mainly server side DBMS tools such as:  
 Locking techniques, Rollback and Commit operations to ensure transaction integrity.  
 Backup and recovery through Transaction/ReDo Logs.  
 Consider recovery techniques provided by supported tools that detect uncommitted transactions due to system or software checks.