

**THE BCS PROFESSIONAL EXAMINATION  
Certificate**

**April 2001**

**EXAMINERS' REPORT**

**Information Systems**

**QUESTION ONE**

You have been appointed to investigate the admissions processes of a local college and to design an on-line system.

Students apply to the College to study for a particular award. They may make more than one application but can only be offered one full-time course provided they have the appropriate qualifications. They complete the application form and submit it to the College Admissions Office where the form is checked to make sure it is completed correctly. If there are any errors then the forms are returned to the student for amendment. Once the forms are correct they are passed to the Academic Admissions Tutor who has three options: to make an offer for one course, offer an alternative course or reject the application. The student is sent a letter indicating the tutor's decision and is asked to accept or reject any offer made. Once the offer has been accepted, the student details are entered on to the Admissions File. At the start of the course, students are registered by the Admissions Office and are allocated to a tutor group. Each tutor group has the same timetable for lectures but a different timetable for tutorials. Only one lecturer teaches a lecture, whereas a different lecturer teaches each tutorial.

a) Draw a Context Diagram and a set of Data Flow Diagrams to depict the above system. (10 marks)

b) Draw a Data Model identifying the main Entities and Relationships, indicating the degree of relationship and optionality. (10 marks)

c) Design a set of screens which would be used by:  
i) the student to apply for a course  
ii) the Admissions Tutor to make an offer  
iii) the student to accept/reject the offer (10 marks)

This question was not answered well. Students appear to be unable to put techniques into practice. The weakest areas were the identification of entities and relationships which, even if these techniques are not actually used in the students' own environment, form a crucial basis for the database design within many conventional systems. The use of storyboards for screen design should also be emphasised. Many of the screens in the answers would be totally impractical. Course providers could help candidates by give them more practice using very simple examples.

## Answer Pointers

The context and data flow diagrams should identify the external entities, data flows, processes and data stores. They should be understandable.

External entity - student.

Processes - student application, verification of application form, making an offer, accepting an offer, allocating tutor groups.

The entities will be student, application, offer, rejection, acceptance, tutor group, lecturer. Optionality would exist around the offer, possibly an arc could be used to indicate offer or rejection.

Screens should be clear, contain appropriate headings, be common in look and feel.

They should be understandable and functional. Consideration should be given to help, use of radio buttons, icons, navigation to and from the screen.

## QUESTION TWO

**A methodology has been defined as 'a recommended collection of rules, tools, techniques, documentation, management and training for the development of information systems'.**

- a) **Give the main reasons why a methodology is a requirement for information systems development within the business environment.**  
(5 marks)
- b) **Describe the main stages within a structured methodology with which you are familiar. Identify the main techniques used at each stage.**  
(15 marks)
- c) **When investigating a system, a feasibility study should be carried out to ascertain the problems and requirements of the existing and proposed new system. Identify the issues that would normally be included in a feasibility report.**  
(10 marks)

This question was answered reasonably well, although inevitably there was repetition between part (ii) and (iii). Candidates should try and distinguish between description of stages and techniques compared with the content of reports produced at each stage. The benefit of the doubt was given to candidates who tried to argue that the waterfall method and prototyping were structured methods.

## Answer Pointers

The reasons for part (i) could include rigorous planning, an integrated approach, to provide competitive advantage, ease of monitoring and control, documentation, efficiency and effectiveness, an increase in productivity, quality assurance, etc.

Main stages – feasibility study, requirements analysis investigating current environment and business systems options, requirements specification - definition of requirements, logical systems specification in terms of technical systems options and logical design, physical design.

Techniques - data modelling, dataflow diagrams, normalisation, entity life histories etc.

Other methods would be acceptable e.g. soft systems, RAD, prototyping, UML, Yourdon, IE etc

Feasibility - assessment of current business systems, aims and objectives, economic, social, operational, technical, legal issues, alternatives.

### **QUESTION THREE**

**Information is said to be the most powerful resource within a business organisation.**

- a) **Discuss how information flows in a typical organisation hierarchy, giving examples of the type of information at each level.** (6 marks)
- b) **Define what is meant by each of the following:**
- i) **Executive Information System**
  - ii) **Management Information System**
  - iii) **Transaction Processing System**
- (9 marks)
- c) **Draft a memorandum to the Information Systems Manager of a large retail company describing what measures you would take to ensure complete security of all the information held on the computers.** (15 marks)

Candidates tended to repeat part of the answers to part (a) in part (b), not being able to distinguish between the type of information and software designed to process it. Section (iii) enabled candidates to discuss security issues in a wide context but many seem to concentrate on security of a computer room rather than other areas such as security of data and therefore lost marks.

### **Answer Pointers**

Operational, tactical and strategic levels are the three levels of decision making within an organisation. Information flows both ways between each level from top management (strategic) to the operational level. Executive decisions would be made on aggregated information; these would be random and unstructured and deal with long range planning. Typical sources would be government policies, the market, competitors etc. Tactical decisions are more structured and timely i.e. periodic or monthly and tend to include administration at management level, forecasting, budgeting etc. Operational information is the day to day processing and relates to the processes within the organisation

EIS - integrates data both external and internal; are interactive; may include artificial intelligent systems; use graphics and simulation techniques and used by senior management.

MIS - summarises transaction data, high volume, simple models, routine reports, low level analysis producing summary and exception reports and used by middle managers.

TPS - transactions, events, deals with sorting, listing, merging, updating, provides detail reports and lists and used by operational personnel and supervisors.

Security issues - all aspects need to be included for both hardware and software, the environment in terms of organisational, logical and physical security.

Typical areas - usernames, passwords, roles, use of views, database management system features such as referential integrity, constraints, triggers, encryption techniques, pin numbers, virus scanners, firewalls, locks, computer room systems, back-up, fireproof safes, contingency plans, disaster plans, insurance, use of intranets, more modern approaches such as retina scans, palm/finger prints, voice recognition etc.

#### **QUESTION FOUR**

**Your company has been advised that it is losing its business as it is failing to keep up to date with new technology.**

- a) **You have been asked to prepare a report explaining how the Internet and the introduction of database management systems, multimedia and object oriented technology have been used by companies to increase their competitive advantage. Draft the report requested.** (15 marks)
- b) **The introduction of new technology will require new staff appointments. Briefly describe the functions of the following:**
- i) **Network Administrator**
  - ii) **Database Administrator**
- (10 marks)
- c) **As a member of the British Computer Society explain how the Society's Code of Conduct might impact on the introduction of new technology.** (5 marks)

This was a straightforward question and most candidates proved that they have kept up to date with recent technological advances. Very few provided evidence that they understood what was meant by professionalism.

#### **Answer Pointers**

Definitions of the four technical areas were expected; i.e. internet - what is it, how it works, the problems etc. A database management system is software which is used to define and control company data, providing integrated, summary and consolidated information. Multimedia is the combination of media other than text which is the normal medium for processing information and includes speech, sound, pictures, video clips making the presentation of information more user friendly and understandable. Object oriented technology enables the use of objects that can be

defined by encapsulating data definitions as well as processing methods and which promote reusability. Trading, advertising and communicating over the internet would obtain competitive advantage.

A network administrator is responsible for the running, support, maintenance and security of the network, dealing with various protocols and topology.

A database administrator is responsible for the database design and definition, control, security, maintenance, consistency, integrity, optimisation etc. Both have managerial responsibilities and must deal with quality, planning, technical aspects and co-ordination with users and developers.

Professionalism is concerned with standards, competence and conduct. With regard to the BCS this encompasses technical capability, accountability and personal integrity. Employers, clients and the public are entitled to a competent and professional approach to work carried out by a BCS member.

## **QUESTION FIVE**

**Certain terms associated with data modelling are often used interchangeably. Explain precisely the differences between each of the following pairs of terms:**

- a) Entity Type and Class**
- b) Generalisation and Aggregation**
- c) Conceptual models and Logical models**

**(3 x 4 marks)**

Most candidates could provide fairly good knowledge of individual terms but often candidates could not clearly explain any differences. Many candidates seemed confused by generalisation and aggregation despite the clearly stated context of the question. Many candidates could not see any association between the terms for part c), where a logical model can be derived from a conceptual model and vice versa.

### **Answer Pointers**

The question referred to the following data modelling concepts:

Entity Type - a collection of objects with similar attributes. A metaphor for a real world object intended to model only data relationships. In contrast a Class is a conceptual metaphor and is implemented in a Object Oriented Program. It is intended to model both data and processing (methods).

Generalisation is a data modelling construct used to depict parent-child relationships; in contrast aggregation models whole part structures (e.g. composition of parts to make a whole)

Conceptual models relate to abstract and real world concepts. The semantics of an information system are represented by modelling constructs to accurately model complex relationships between data objects.

In contrast logical models are close to the machine and are intended to be an abstraction of physical constructs such as files. Thus a relation is a logical construct that can depict a physical file.

## QUESTION SIX

- a) Explain what is meant when a web site presents 'static' information content in its web pages. (4 marks)
- b) What technology is needed, and why, to enable a web site to present 'dynamic' information content in its web pages? (8 marks)

Most candidates knew that HTML is a presentation tool for information content on web pages. However many candidates could not properly explain what dynamically changing really means; in certain cases it was falsely perceived as the effect of users activating hyperlinks through <HREF> tags. Another feature is that it is presented onto static web page and not affected by user interaction apart from hyperlinks set up in HREF tags.

Answers varied in terms of what candidates understood as dynamic content. Clearly client-side scripting (e.g. JavaScript) has no effect on making information content dynamic rather it makes user processing and navigation more interactive. The only way that changes to the information content is realised is by users being allowed to update the data content as defined in the answer pointer (essentially server side scripting and CGI-based programs). Candidates who mentioned the animated graphics attracted a few marks but these tools are not central to the provision of data subject to changes perhaps made by other users accessing the same database from another site. It was pleasing to see some candidates had kept up to date with this fast moving technology and knew about Servlets and supporting Java technology.

### Answer Pointers

Changes made to web sites such as shopping marts are said to offer dynamic data content when data updates (possibly from different users) are reflected in the state of a remote database connected to a web server. Static content occurs when the information content is unchanging or the web author has not kept this up to date using conventional HTML coding. Most web sites do not use a database and they are criticised for being out of date and not changing because of the need to hand-code these changes (in HTML) as they occur.

The technology to support dynamic web pages is well established and founded on server side scripting and the Common Gateway Interface (CGI). Techniques based on CGI include ASP and JSP. The main ideas behind the technology are expected but the detail of coding or the technical issues are not expected at this level. The key features are HTML Forms and the concept of programs (CGI scripts) running on the web server to effect changes to a database and the return of data back to the web browser to be presented in native code i.e. HTML (or XML).

## QUESTION SEVEN

The following methods are frequently chosen to design information systems:

- a structured method (e.g. YOURDON)
- an object oriented method (e.g. Unified Modelling Language (UML))
- a Rapid Application Development approach

**Describe the distinctive principles and the motivations behind these methods.  
(12 marks)**

This question was generally well answered, apart from a certain lack of knowledge in the area of Object Orientation. Most candidates could provide fairly convincing distinctions in approach, but it was slightly disappointing that the bracketed methodologies (e.g. Yourdon, UML) or any others, were rarely mentioned. Thus a practical flavour to candidates answers was often absent.

### Answer Pointers

The distinctive principles and motivations are:

Structured Methods are used for large systems where the requirements are known in advance. The principles behind structured methods are based on a 'waterfall' approach.

OO methods are motivated by the adoption of OO programming in mainstream information systems. They use methodologies that support the ease of translation between design and implementation. UML is a widely used OO method and features modelling tools suited to modern interactive component based systems.

Rapid Application Development is motivated by incremental design and development where the user requirements are ill-defined or for developing prototypes for larger systems. There are no established methodologies as such, rather guidelines and support tools to secure success in capturing the user requirements.

## QUESTION EIGHT

**Suppose you are about to develop an information system. There are different types of software tools and many products that you could use. Describe the functionality you would expect to be provided by ONE of the following types of software tools:**

- a) A CASE tool (products include Rational Rose, Symmetry, Visio) OR
- b) A Web Authoring tool (products include Dreamweaver, Flash, FrontPage)  
OR
- c) A Report Generator (products include Crystal, RPG3)

**Your answer should refer to either one of the products listed above or one of your own choice.**

**(12 marks)**

There were a large number of candidates (about 25%) who misread the question and answered three software tools rather than one! Surprisingly another, smaller number of candidates dreamt up a software tool of their own and answered the question

based on that. Most candidates could provide fairly good knowledge of a tool but it was apparent that some candidates had hardly ever used these tools for development. Therefore the best answers were from those candidates that could describe their development experience using these tools; for example to develop a web site (web tool) or an information system (CASE), or a report for presentation. Some candidates chose less sophisticated software tools usually being a minor part of an integrated software tool, this narrowed down the scope of answers and thus the marks awarded.

### **Answer Pointers**

The question was intended to assess the candidate's understanding (ideally from practical exposure) of significant tools and techniques available in the chosen software package. Answers should show the user interface, the functionality of the most important tools, the integration with other tools and operating software such as databases, operating systems, internet etc where appropriate.

## **QUESTION NINE**

**Explain the meaning of the following relational database terms:**

- a) **Compound or Composite Key**
- b) **Join condition**
- c) **Schema**
- d) **Null value**

**(4 x 3 marks)**

A large number of candidates either guessed or misread the question as many answers referred to similarly named terms used in other contexts. These parts are quite closely bound as a similar example could be used throughout and thus reinforce the answer. This opportunity was only evident in the very best answers. Instead many answers consisted of irrelevant detail missing the point of the question or the clearly stated context.

### **Answer Pointers**

Each part requires a clear explanation of the meaning of terms in the context of relational databases. The examiner also expected simple illustrative examples of how these terms are applied in practice.

Compound/Composite are combinations of attributes used to form a unique key for a Relation. Usually Compound keys are found in link tables or relationship relations. A Join condition can be expressed as an SQL clause that defines the common attributes of two relations that participate in a query. The familiar equi-join is an example where join conditions can be formulated.

A Schema defines the static structure of the relational model. Again this would be implemented in code (SQL) and would be used to CREATE the relations for a database. Schemas can also enforce constraints such as those used for referential integrity and for checking domain ranges of data values.

A Null value is a value associated with a particular domain that is missing or not



applicable. Nulls are allowed in relations and the keyword NULL can be used to reference them in a schema or SQL query.

## QUESTION TEN

Facts about the real world can be expressed as binary relationships using the notation:

**Relation(Attribute1,Attribute2)**

where Attribute1 represents a unique Identifier and Attribute2 represents a variable which is functionally dependent on Attribute1.

Consider the following binary relationships:

**PersonName(45023,"Bill Fernandez")  
PersonName(67121,"Owen Smith")  
CarRegNo(712,"TVR545W")  
CarMake(712,"Ford")  
CarMake(709,"BMW")  
CarEngine("E3430/7",712)  
CarEngine("E9745/4",709)  
CarEngine("E9745/2",709)  
EngineSize("E9745/2",1.6)  
EngineSize("E3430/7",1.8)  
EngineSize("E9745/4",1.9)**

a) Using the above facts derive the following information:

- i) What is the engine size of the car registered as "TVR545W"?
- ii) What engine sizes can be fitted in a "BMW"?

(4 marks)

b) Express the following facts as binary relationships:

- i) The fact that cars made by "Ford" have either a model name of "Galaxy" or "Scorpio"
- ii) The fact that "Bill Fernandez" owns both a "Galaxy" and a "Scorpio".

(8 marks)

Answers for this question were generally poor. Part a) was straightforward while part b) required a bit more work than most candidates realised. This involved the extra facts that ensured the binary relationships could be navigated and associated.

Candidates' workings for this types of question should always be given (and not crossed out), so that the examiner can see how the answer (even if incorrect) was arrived at. Also any assumptions should be made where appropriate.

## Answer Pointers

Part a) The supplied facts can be associated by their identifier (attribute1) thus:

```
CarRegNo(712,'TVR545W') => CarEngine('E3430/7',712)
                        =>EngineSize('E3430/7',1.8)
```

Answer = 1.8

Similarly

```
CarMake(709,"BMW")=>CarEngine("E9745/4",709),
                  =>CarEngine("E9745/2",709)
                  =>EngineSize("E9745/4",1.9),
                  =>EngineSize("E9745/2",1.6)
```

Answer=1.6 and 1.9

Part b) CarModel(123,"Scorpio")

CarModel(124,"Galaxy")

where 123,124 are the unique identifiers for these two facts. We now need to make the association with the CarMake facts that already exist.

```
CarModelsMade(123,712),
CarModelsMade(124,712)
```

Note cars with the same model name may be made by different manufacturers or following a change of name for the Car Make.

In part (ii) of b) a similar approach is followed using the new facts defined above.

PersonName(45023,"Bill Fernandez")

CarOwner(45023,123),

CarOwner(45023,124)

We can derive CarMake ("Ford") by following the association back using 123 and 124 as foreign keys. Note that the boolean operator AND is implicit as each fact is separated by a comma (hence read as AND...).

## QUESTION ELEVEN

**Design a user interface for the following scenario:**

**You are required to simulate a point of sales checkout in a busy supermarket. Assume there is no bar code reader, therefore the checkout operator has to manually key in the product code of the goods purchased, and the quantity purchased. A data file is used to retrieve the product description and the price of a product purchased. The product code is located on the product packaging above the bar code. After a valid product code and quantity has been entered, the description and cost is displayed. This is repeated for each product purchased. A running total of the customer purchases will also be displayed and a final total produced for each customer. Your display should be refreshed ready to process further customers.**

**Your design should include:**

- **A diagram showing the structure of your user interface.**
- **A series of sketches showing the interaction between the checkout operator and your user interface.**

**(12 marks)**

Generally many candidates presented scrappy design diagrams which didn't follow any logical order. Screen designs with little background to the design logic produced low marks. Many candidates neglected the interface between the Form and the Database, which is why the first step should be in effect to specify the data structure.

### **Answer Pointers**

The following stages should be followed to avoid the production of scrappy verbose answers:

1. Work out the Table structure and attributes. (Basically a Product Inventory and Transaction Table is all that is needed)
2. Design the decision logic using a flow chart or similar. (Fairly straightforward logic involving simple iteration/selection procedures).
3. Draw a Form to represent the Table structure. (Candidates should have represented a One to Many relationship as a Form/SubForm or Master/Detail).
4. Add appropriate controls or function keys to support the user operations on the Form. (Note these need not be GUI controls such as command buttons etc.).
5. Determine the actions that are needed to add an item purchased and when the data is updated and refreshed on the Form. (This is simple I/O but a decision has to be made about the timing of read/writes to/from the database.)
6. Draft out screens to demonstrate the stages above.

### **QUESTION TWELVE**

**The data held in corporate databases is a valuable resource and may contain sensitive information which needs protecting. Describe the techniques that are used to protect corporate databases from the following threats:**

- **theft by employees**
- **accidental loss**
- **corruption of operational data arising from the failure of the hard disk containing the data**

**(12 marks)**

A broad range of answers was provided and these were accepted so long as assumptions were stated and the context was given. Clearly some candidates were familiar with security practices from their own experience and some mentioned new and emerging technologies such as image and voice recognition. Most important though was the avoidance of repetition of techniques across the different threats and the development of an overall security strategy that covered every eventuality.

Discussion about hardware technologies such as RAID was apparent in some

answers, this attracted only a few marks; the Information Systems syllabus is examining principally software techniques.

### **Answer Pointers**

Existing software techniques should be prominent in this answer such as:

- Passwords/SSL/encryption/GRANTS/REVOKES etc.
- Backup Procedures/ proper audit trails,
- Transaction Logs, Recovery via Checkpoints and Before/After Images taking of the database state, respectively.