# THE BRITISH COMPUTER SOCIETY

## THE BCS PROFESSIONAL EXAMINATIONS
Diploma

## DATABASE SYSTEMS

20th October 2005, 10.00 a.m.-12.00 p.m.
Answer FOUR questions out of SIX.  All questions carry equal marks.
Time: TWO hours.

*The marks given in brackets are **indicative** of the weight given to each part of the question.*

1.  The following concepts are important parameters when judging the effectiveness of data storage solutions.  For EACH concept, briefly compare and contrast how effective the database approach and file-based approach are, highlighting any particular strengths or weaknesses of either.

    *a)*   Data Integrity
    *b)*   Data Security
    *c)*   Data Redundancy
    *d)*   Data Maintenance
    *e)*   Data Consistency                                                                 **(5 x 5 marks)**

2.  Using <u>your own SQL code examples and any appropriate diagrams</u>, discuss and explain all the relevant concepts and constructs that must be addressed and implemented by a database developer or administrator when satisfying the following database issues:

    *a)*   Security constraints (on users)                                                    **(15 marks)**
    *b)*   Integrity constraints (on data)                                                    **(10 marks)**

3.  Explain the purpose of the ANSI/SPARC 3-level architecture for a database management system, and describe the functions of each level giving examples to illustrate your arguments.          **(25 marks)**

4.  Consider the following relations (primary keys are underlined):
    AUTHOR (<u>AName</u>, name, address, speciality)
    PUBLISHER (<u>PName</u>, name, Location)
    BOOK (<u>Title</u>, AName, PName)
    Where
    AUTHOR contains author details and **AName** is the primary key.
    PUBLISHER contains publisher details and **PName** is the primary key. BOOK contains details of the book and its primary key is title **(Title)**.

    Write relational algebra statements for each of the following queries:

    *a)*   What are all titles published by *Pitman*?
    *b)*   What is the speciality of all authors publishing a book with *MIT Press*?
    *c)*   What is the location of the publisher of the book '*A guide to DB2*'?
    *d)*   Get the names of all publishers publishing a book by *Smith* and a book by *Jones*?
    *e)*   What are the addresses of all authors publishing a book with all the publishers who located in *Paris*?                                                                            **(5 x 5 marks)**

**Turn over]**

**5.** Read the following scenario then attempt the task that follows.

**Scenario**
You are a database consultant and you have been given a contract to build a corporate database for a large manufacturing company. The company has many departments and each department has a database to support its own data processing requirements. The local databases that run in these departments are a mixture of flat file databases and relational databases.

You are required to merge all the local departmental databases into one centralised database. A centralised approach is seen as a way of controlling the duplication of data and resources. It is also seen as an opportunity for the company's directors to develop an improved management information system so they can analyse company wide information such as resource planning and comparative performance of departments. A phased approach to development is recommended to minimise the loss of service to the existing systems.

**Task**
Produce a report for the technical director of the manufacturing company that will include a description of the phases of development and outline any risks associated with each phase. **(25 marks)**

**6.** Read the following discourse then answer the questions that follow.

**Discourse: Health Centre Application**
There are many doctors assigned to treat patients at a health centre. Patients must be registered with an associated doctor before they can book an appointment. However a patient when attending an appointment may not always see their own doctor, instead they may see another doctor working at the health centre.
The doctor sees the patient and he/she then makes a diagnosis of the illness/ailment. Medicines (if required) to treat the illness/ailment are recorded by the doctor on a form called a prescription. There may be many medicines recorded on a prescription and there may be many prescriptions for a patient if they have many illnesses/ailments. The patient is given prescriptions so that they can collect/buy the medicines from a local drug store or pharmacist. The doctor also records the details of the prescription this includes the medicine name, the category and the dose (amount taken and frequency) and other instructions if applicable (eg avoid alcohol). Repeat prescriptions (where a prescription extends over a period of time) are usually sent to the patient by post.
Medicines are classified according to their use, eg flu remedies, skin complaint remedies. Some medicines may fit into more than one category, eg penicillin.
        The following query (QUERY1) needs to be supported:
*List all the prescriptions made out to patient 'X' that were prescribed by doctor 'Y' involving medicines of category = 'Penicillin'. List the patient ailment/illness, the medicine, the date, the dose for each prescription dispensed and indicate whether it is a repeat or single prescription. Also list the date and time of the original appointment from which the prescription was dispensed.*

*a)* Produce a logical data model for the above discourse. Your model should represent:
    *i)* The entities.
    *ii)* The relationships.
    *iii)* Multiplicity of the relationships, ie cardinality and optionality.
    *iv)* Draft tables required (including the primary and foreign keys).

    Justify any modelling decisions and state any assumptions you have made. **(18 marks)**

*b)* Show with the aid of a diagram the access paths to the tables required to execute QUERY1. Justify the benefits of using access paths during database design. **(7 marks)**