

THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATION Certificate

TECHNOLOGY

11th October 2004, 2.30 p.m.-4.30 p.m.

Time: TWO hours

SECTION A

Answer TWO questions out of FOUR. All question carry equal marks.

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

1. a) A computer's architecture is defined by its assembly language instruction set. Assembly language, the human-readable form of a computer's machine code, performs primitive operations on data in memory locations or in registers.

Assembly language instructions specify an operation and one or more operands; for example, ADD 1234, D0 adds the contents of memory location to data register D0. The location or value of an operand is specified by means of an addressing mode. Explain the effect of EACH of the following three addressing modes and give examples of their application (use diagrams where necessary).

- i) literal (or immediate) addressing
- ii) direct (or absolute) addressing
- iii) register indirect (or indexed) addressing

(10 marks)

- b) For a computer of your choice, translate the following high-level language construct into assembly language. Note that the computer you describe may be real or hypothetical.

You must define the action carried out by each of the instructions you use in plain English. You are encouraged to use register transfer language, RTL, to define operations.

S = 0	;form inner product of X and Y
For i = 0 to n - 1	;preset sum S to zero
S = S + y _i + x _i	;REPEAT
End for	; add pair of products to the sum
	;Until n products added to total

(15 marks)

- c) Some computers provide an addressing mode called *relative addressing* or *program counter relative addressing*. Explain the operation of this addressing mode, its advantage to the programmer, and show how it might be used.

(5 marks)

Turn over]

2. Few inventions have done more to promote the growth of computing than the Internet and the World Wide Web.

However, the very Internet that has done so much to help computing is beginning to suffer from problems caused by the spreading of *malware*. The word *malware* (**malicious software**) indicates software that has either a harmful effect (e.g., virus) or is a nuisance (SPAM).

Describe the various types of malware that are currently affecting computers and networks and discuss what steps the computer manufacturers, operating system designers and network implementers can take to prevent the spread of malware. **(30 marks)**

3. Modern operating systems perform two functions. They provide a user interface, they control the system hardware and allocate resources. Explain how the operating system makes use of the following two hardware (machine-level) facilities. You should describe each of the two mechanisms and you should provide diagrams to illustrate your answer.

- a) The role of interrupts (i.e., exceptions) **(15 marks)**
- b) Memory management unit, MMU **(15 marks)**

4. A high-performance computer such as a PC has a memory hierarchy; that is, it supports several memory subsystems, each of which is constructed with a particular technology and which performs a specific role in the computer system. These memory subsystems range from cache memory to DVD drives.

- a) Explain why a computer cannot use a single memory technology and why a memory hierarchy is necessary. Your answer should discuss the role and characteristics (i.e., performance) of each of the individual memory technologies you would expect to find in a high performance general-purpose digital computer. **(15 marks)**
- b) Briefly describe the technologies used to implement each level in a memory hierarchy. **(15 marks)**

NOTE: Part *a*) is concerned with the *performance* of the memory subsystems, whereas part *b*) is concerned with the operation and construction of the memory subsystems.

SECTION B

Answer FIVE questions out of EIGHT. All questions carry equal marks.

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

5. Describe what the following terms mean:

- a) Interpreter
- b) Translator
- c) Compiler **(3 x 4 marks)**

6. a) Draw a truth table for the following function: $AB + CD$
b) Implement the function using NAND gates only **(2 x 6 marks)**

7. Perform one-bit right circular rotation on the following byte patterns, giving your answers in hexadecimal:
- a) CD
 - b) BE
 - c) 37
- (3 x 4 marks)**
8. In programming languages, what is the difference between:
- a) Global variable and local variable
 - b) Boolean and Floating-point data types
- (3 x 4 marks)**
9. Describe, with illustrations, THREE different network topologies. Outline one advantage and one disadvantage of each topology described.
- (12 marks)**
10. State the functions of the following:
- a) ALU
 - b) Program Counter
 - c) Instruction Register
- (3 x 4 marks)**
11. Convert the following numbers to their decimal value:
- a) 1100.1110
 - b) BAE
 - c) FE+1D
- (3 x 4 marks)**
12. In your own words, explain what is meant by the following terms:
- a) Artificial Intelligence
 - b) Expert Systems
 - c) Robot
- (3 x 4 marks)**