# THE BRITISH COMPUTER SOCIETY 

# THE BCS PROFESSIONAL EXAMINATION <br> Certificate 

## TECHNOLOGY

$23^{\text {rd }}$ April 2003, 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. Consider the high-level constructs:

$$
\begin{aligned}
& x=4 \\
& y=5 ; \\
& z=x+y ;
\end{aligned}
$$

a) Describe, with the aid of diagrams, a general-purpose digital computer that can perform these operations. Your description should include reference to functional units such as buses and registers.
(10 marks)
b) What sequence of events takes place when the above fragment of code is executed on the computer you described in part $a)$ ? Your answer should be pitched at the "register transfer level".
(10 marks)
c) All modern computers provide an addressing mode that is sometimes called "memory indirect addressing" or "indexed addressing" or "pointer based addressing".

Explain what this addressing mode is and how it is used. Give a typical example of the use of this indirect addressing mode.
(10 marks)
2. a) Describe the basic operating principles of a hard disk drive that uses magnetic recording technology.
(10 marks)
b) Briefly describe the progress made by hard disk technology over the past few years (i.e., improvements in capacity, access time, reliability, latency, interface).
c) What is flash memory and why is it so important in computer systems?
d) Why is flash memory having such an impact on digital systems and computer-based systems generally? Provide appropriate examples.
(6 marks)
3. The operating system is arguably the most important piece of software that runs on a general-purpose computer.
a) Why is the operating system considered such a key element of a general-purpose computer?
(10 marks)
b) Describe how a computer's interrupt-handling mechanism can be used by the operating system to support input/output operations.
(10 marks)
c) Two operating systems are competing for the world market for personal computers, workstations and servers. These are Microsoft's Windows ${ }^{\mathrm{TM}}$ and Linux. What are the fundamental differences between these two operating systems and explain why Windows and Linux are locked in such a gigantic struggle?
(10 marks)
4. Digital information cannot be directly transmitted across the public switched telephone network (PSTN).
a) Explain why this statement is true.
b) What techniques may be used to transform digital information into a form that can be transmitted over the PSTN?
c) Describe the characteristics of a modern modem.
(5 marks)
d) Over the past few years, the maximum rate at which PCs can transmit data across the PSTN has increased. Discuss current developments in data transmission and modem technology that are leading to further improvements in data rates.
(7 marks)
e) A few years ago, devices such as modems and printers were invariably connected to a computer via an RS 232 data link (now known as EIA 232). Today, the serial interface provided by RS 232 is becoming less popular and is being replaced by the USB (universal serial bus) interface. Explain why USB has become so much more popular than RS 232.
(8 marks)

## 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. a) You are asked to install a PC in a small office. You are told that the computer should be "as reliable as possible" because the effect of down time can be expensive. What steps would you take to ensure that the computer was reliable?
( 6 marks)
b) A computer has a memory system that consists of a hard disk controller card and two hard disk drives. The memory system is usable as long as the controller and at least one of the hard disk drives continues to function.

If the probability of the controller failing in a year is 0.01 and the probability of a hard disk failing is 0.2 in a year, what is the probability of the system failing in a year?
(6 marks)
6. a) Why is an interface necessary to connect an external peripheral to a CPU?
b) Define what is meant by Direct Memory Access and describe its operation.
7. Describe the primary use of each of the following memory devices, and state whether the device is volatile or not:
a) Cache
b) Registers
c) RAM
d) ROM
(12 marks)
8. A Boolean expression in four variables is expressed as:

$$
\mathrm{F}=\mathrm{AB} \overline{\mathrm{C}}+\mathrm{ACD}+\overline{\mathrm{ABCD}}+\mathrm{ABCD}+\mathrm{A} \overline{\mathrm{BCD}} \overline{\mathrm{D}}
$$

a) Express the function $F$ as a simplified Standard Sum of Products.
(6 marks)
b) Draw a circuit diagram that implements the simplified function F .
(6 marks)
9. Carry out the following binary operations:
a)
i) $\begin{array}{ll} & 111000 \\ A N D & \\ 101001\end{array}$
ii) $\quad 111010$
101101
iii) 111001
XOR
111001
b)
i) 111100
$A D D$
101001
ii) 011100
$\begin{array}{ll}A D D & \\ & 001001\end{array}$
(6 marks)

Comment on the results of the two additions assuming all the numbers are two's complement numbers.
(6 marks)
10. With respect to local area networks, state the meaning of the following terms: topology, protocol and medium.
(6 marks)
Differentiate between peer-to-peer and client-server network architectures.
(6 marks)
11. Briefly describe the characteristics of each of the following programming languages:
a) machine language
b) assembly language
c) high-level languages
d) fourth generation languages.
12. The following are part of the instruction-set of a simple computer:

LD0, i - Load accumulator (immediate mode);
LD1, m - Load accumulator (direct mode);
LD2, m - Load accumulator (indirect mode);
AD0, i - Add to accumulator (immediate mode);
AD1, m - Add to accumulator (direct mode);
AD2, m - Add to accumulator (indirect mode);
ST0, m - Store contents of accumulator in specified location;
HLT - Halt
where i is a constant (immediate, literal) and m is a memory location.
Given the contents of the computer's memory shown below, state what happens when EACH of the following instructions are carried out:
i) LD2, 101
ii) AD1, 102
iii) AD0, 103
iv) $\mathrm{ST} 0,104$

| Location <br> No. | Content |
| :--- | :--- |
| 101 | 105 |
| 102 | 104 |
| 103 | 103 |
| 104 | 102 |
| 105 | 101 |

