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THE BRITISH COMPUTER SOCIETY
THE BCS PROFESSIONAL EXAMINATION
Certificate

TECHNOLOGY

17th October 2000 – 2.30 p.m. – 4.30 p.m.
Time: TWO hours

SECTION A

Answer TWO questions out of FOUR from this section. All questions 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 CPU consists of **registers**, **buses**, the **ALU**, and a **control unit**. Describe the characteristics of each of the terms in bold font and explain what role each item plays in a computer. **(15 marks)**
- b) The conventional Von Neumann computer uses a *fetch-execute* cycle to read instructions from memory and execute them.

With the aid of diagrams, show how such a computer operates and use the diagrams to explain the sequence of events that takes place during the fetching and executing of an instruction. **(15 marks)**

2. The introduction of the Internet has made the personal computer vulnerable to malicious threats.

Describe, in detail, these threats to the personal computer and explain what action can (or cannot) be taken to defeat them. **(30 marks)**

3. a) What are standards and protocols in the context of computer communications and why are they so important? **(8 marks)**
- b) Briefly describe either a physical layer (e.g. RS232) or a data link layer protocol (e.g. HDLC) that is used in computer communications systems. Explain how the protocol you have described is used to permit two computer systems to communicate with each other. **(12 marks)**
- c) What are the relative advantages and disadvantages of the following communications transmission paths:
- i) Microwave link
 - ii) Fibre optic link
 - iii) Satellite link
 - iv) Coaxial cable link
- (10 marks)**

4. “The most important piece of software that a computer such as a personal computer will ever run is the operating system.”

Explain why an operating system is so important to the success of a computer and describe the range of functions an operating system offers the user. **(30 marks)**

[Turn over

SECTION B

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

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

5. a) What is the fundamental difference between a combinational logic element (such as an AND/OR/NOT gate), and a sequential element (such as a flip-flop)? (4 marks)
- b) Draw the circuit diagram, and specify the truth table, for a half adder. (6 marks)
- c) Show how a full adder can be constructed using half adders. (2 marks)
6. A black box has four inputs D, C, B, A representing the values 0000 to 1111 (where D represents the most-significant bit). The inputs represent the decimal numbers 0 to 15, respectively.
- This system has a single output F that is 1, if the number represented by the input is divisible by 3 or 4, and is 0 otherwise.
- Construct a truth table to represent this system and use it to obtain a simplified function for F in terms of inputs D, C, B, and A. (12 marks)
7. A typical high-performance personal computer or workstation contains a wide range of memory devices (from on-chip registers to DVDs).
- Explain why such a range of memory devices is found in a typical computer and describe their characteristics. (12 marks)
8. a) What is a modem and why does the typical domestic computer user require a modem in order to connect their personal computer to the Internet? (4 marks)
- b) Explain the meaning of *asynchronous serial data transmission* and describe why it offers such an inefficient means of data transmission. (4 marks)
- c) The two most popular network topologies are the ring and the bus (e.g., Ethernet). Define these two topologies and discuss briefly their relative merits. (4 marks)
9. a) A computer, at the machine level, uses an *addressing mode* to access an operand. The addressing mode determines how the operand is accessed in memory; for example, by means of direct (absolute) addressing or indexed (register-indirect) addressing.
- Describe the range of addressing modes supported by a typical microprocessor and explain how they are used to access operands in memory. (8 marks)
- b) Explain how virtual memory is used to run a large program on a computer with a smaller memory (random access main store) than the program. (4 marks)

10. Define the following terms:

- a) Multimedia (4 marks)
- b) Hyper Text Markup Language (4 marks)
- c) CGI (4 marks)

11. a) Most modern computers, from PCs and Workstations to embedded microprocessors in automobiles, employ interrupt-driven input/output. Explain how a computer's interrupt mechanism operates and how it is used to implement I/O transactions. (7 marks)

b) An input or output operation can be described as open loop or closed loop. A closed loop transaction is one that involves handshaking. Explain the meaning of **closed loop** and **open loop** in the context of I/O operations. (5 marks)

12. a) Convert the decimal number 119.75 into a 16-bit fixed-point sign and magnitude binary number. Assume that the number has a sign bit in the bit 15 position, a 10-bit integer part, and a 5-bit fractional part. (4 marks)

b) Convert the decimal numbers -12 and +37 into two 8-bit two's complement values. (4 marks)

c) Add the two binary numbers you obtained in part b) together and convert the result into a decimal value. (2 marks)

d) In the context of two's complement arithmetic, what is the meaning of "arithmetic overflow"? (2 marks)