Calculators may be used in this examination provided they are not capable of being used to store alphabetical information other than hexadecimal numbers

UNIVERSITY OF BIRMINGHAM

School of Computer Science

LC Computer Systems and Professional Practice

Sample Exam Paper

Time allowed: 2 hours

[Answer all questions]

Turn Over

Note

Answer ALL questions. The paper will be marked out of 100.

Question 1

(a) Justify the use of the binary number system in computer systems. **[5 marks]**

(b) (i) Convert 46_{10} to an unsigned binary number. **[2 marks]**

(ii) Convert 1001101001101011_2 to hexadecimal. **[2 marks]**

(iii) Show how -17_{10} can be represented using two's complement. **[2 marks]**

(iv) Show how 19_{10} can be subtracted from 49_{10} in two's complement. **[2 marks]**

(v) Using an example, explain the concept of overflow in binary. **[2 marks]**

(c) A 1-bit full-adder performs addition on two bits and a previous carry bit.

(i) Show the truth table and logic circuit for a 1-bit half-adder. **[5 marks]**

(ii) Show how an N-bit full-adder can be designed based on N 1-bit full-adders. Your answer should include the logic circuit for a 1-bit full adder. **[5 marks]**

(d) D-type flip-flops are commonly used in circuit design.

(i) Draw and explain the truth table for a D-type flip flop **[5 marks]**

(ii) Show how D-type flip flops can be used in the design of an N-bit register. Your design should be serial-in, serial-out. **[5 marks]**

(iii) Show how D-type flip flops can be used in the design of an N-bit counter. **[5 marks]**

Question 2

(a) Explain the memory hierarchy using a labelled diagram. Your answer should focus on the motivation for the hierarchy and its role in computer system design. **[10 marks]**

(b) Cache memory is commonly used to improve computer system performance.

(i) Explain the term *cache memory*. **[5 marks]**

(ii) Explain why it is possible to significantly improve performance using relatively small cache sizes. **[5 marks]**

(c) Interrupt-driven I/O is commonly used by computer systems.

(i) Explain the concept of interrupt-driven I/O. Your answer should incorporate the concept of *context switching*. **[5 marks]**

(ii) Outline a situation where interrupt-driven I/O is likely to be unsuitable. Your answer should suggest a more appropriate I/O mechanism. **[5 marks]**

Question 3

(a) Microprocessors comprise of a set of components that interact to provide function.

(i) Explain what is meant by the term *von Neumann architecture*. **[5 marks]**

(ii) Explain the roles of the arithmetic logic unit (ALU), program counter (PC) and instruction register (IR) in program execution. **[5 marks]**

(b) Control units can be designed using a hardwired approach.

(i) Explain the role of the control unit in a microprocessor. **[5 marks]**

(ii) Explain how hardwired control units operate. **[5 marks]**

(iii) Discuss the advantages and disadvantages of using a hardwired approach to control unit design. **[5 marks]**

(c) Explain absolute addressing and relative addressing. Your answer should discuss the implications of using these addressing modes for the development of position independent code. **[5 marks]**

End of Paper

Do not complete the attendance slip, fill in the front of the answer book or turn over the question paper until you are told to do so

Important Reminders

- Coats/outwear should be placed in the designated area.
- Unauthorised materials (e.g. notes or Tippex) must be placed in the designated area.
- Check that you do not have any unauthorised materials with you (e.g. in your pockets, pencil case).
- Mobile phones and smart watches **must** be switched off and placed in the designated area or under your desk. They must not be left on your person or in your pockets.
- You are not permitted to use a mobile phone as a clock. If you have difficulty seeing a clock, please alert an Invigilator.
- You are not permitted to have writing on your hand, arm or other body part.
- Check that you do not have writing on your hand, arm or other body part – if you do, you must inform an Invigilator immediately
- Alert an Invigilator immediately if you find any unauthorised item upon you during the examination.

Any students found with non-permitted items upon their person during the examination, or who fail to comply with Examination rules may be subject to Student Conduct procedures.