A39845

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

First Year Undergraduate

06-40086

LC Computer Systems and Professional Practice

Main Summer Examinations 2025

Time allowed: 2 hours

[Answer all questions]

Turn Over

Note

Answer ALL questions.

Question 1

(a) Explain why it is desirable to have more than one representation for a value. Your answer should provide an example of where this might be useful. **[3 marks]**

(b) (i) Convert 118_{10} to an 8-bit unsigned binary number. **[3 marks]**

(ii) Convert 1111101001101011_2 to hexadecimal. **[3 marks]**

(iii) Show how -44_{10} can be represented using two's complement. **[3 marks]**

(iv) Show how 42_{10} can be subtracted from 56_{10} in two's complement. **[3 marks]**

(v) Using an example, explain the concept of underflow in binary. **[5 marks]**

(c) Combinatorial logic gates can be used to implement Boolean expressions.

(i) Show how the EX-OR function can be implemented using only NAND gates. Your answer should provide a Boolean expression for the EX-OR function. **[5 marks]**

(ii) Show the truth table and 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 shift register. Your design should be serial-in, serial-out. **[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) Outline the implications of Moore's Law for the design of computer systems. Your answers should state Moore's Law. **[4 marks]**

(c) Explain the operation of Dynamic RAM (DRAM). **[4 marks]**

(d) Parity codes can be used to detect errors in message transmission.

(i) Explain how parity codes enable the detection of errors in message transmission. Your answer should provide an example that uses even parity. **[4 marks]**

(ii) Outline the disadvantages of using parity codes for the detection of errors in message transmission. **[4 marks]**

(iii) Show how parity codes for the detection of errors can be computed in hardware using combinatorial logic. **[4 marks]**

Question 3

(a) Microprocessors execute instructions on the basis of a set of interacting components.

(i) Provide a detailed explanation of the fetch-decode-execute cycle. Your answer should provide details of the microprocessor components involved. **[10 marks]**

(ii) Distinguish between micro-instructions and macro-instructions. **[4 marks]**

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

(i) Explain the operation of hardwired control units. **[4 marks]**

(ii) Outline the advantages and disadvantages of adopting a hardwired approach to control unit design. **[4 marks]**

(c) Interrupts are a commonly used I/O mechanism.

(i) Explain the operation of interrupt-driven I/O. **[4 marks]**

(ii) Outline the advantages and disadvantages of interrupt-driven I/O. **[4 marks]**

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.