

PRIFYSGOL CYMRU; UNIVERSITY OF WALES

M.Sc. AND DIPLOMA EXAMINATIONS

JANUARY 2002

SWANSEA

Computer Science

CS M33 Computer Systems

Attempt 2 questions out of 3

Time allowed: 2 hours

Students are permitted to use the dictionaries provided by the University through the invigilators

CS M33
COMPUTER SYSTEMS
(Attempt 2 questions out of 3)

Question 1.

- (a) Convert the decimal number 3055 into hexadecimal. [4 marks]
- (b) Draw the configuration of a full bit adder as a Boolean circuit, in which every signal passes through at most two logic gates. What are the advantages of this configuration over a configuration which makes use of two half-bit adders? [7 marks]
- (c) Convert +2 and -2 into two's complement binary representation with 3 bits. Multiply these numbers using Booth's algorithm. Your result should be represented as a 6 bit binary number in two's complement form. [8 marks]
- (d) In the IEEE 754 floating point standard (single, 32 bits), if the biased exponent is 0, floating point numbers are represented in non-normalized form. Why does one not use the normalized form? Determine further the least number bigger than 0 which can be represented in this standard. You may express your result by a formula. [6 marks]

Question 2.

- (a) Which technology is used for implementing very fast memory? Why is this technology not used for designing all memory devices of a computer? [3 marks]
- (b) What is a combinatorial circuit? Why does one need sequential circuits when constructing a microprocessor? [4 marks]
- (c) Draw the configuration of a D-flip-flop as a Boolean circuit. Determine its output depending on the following sequence of inputs (you can assume that the duration of the clock signals is much longer than the time needed for the S-R-latch to reach a stable state and you can therefore neglect this delay):

Clock	1	0	1	0	1	0	1	0	1	0	1	0	1
D	1	0	0	1	0	0	1	0	0	1	0	0	1

[8 marks]

(d) Give a truth table for the function $f(x, y, z)$, where $f(x, y, z)$ is true if and only if exactly one of x, y, z is true. Determine a Boolean formula in variables x, y, z , which represents this function. [6 marks]

(e) Determine a circuit which is constructed from NAND gates only and has output $x \wedge y$ depending on inputs x and y . [4 marks]

Question 3.

(a) Describe briefly the three main control methods for I/O. [6 marks]

(b) What is the difference between the von Neumann/Princeton architecture and the Harvard architecture? [3 marks]

(c) Assume an architecture with the following assembly language instructions:

Instruction	Meaning
PUSH X	Push content at memory address X on the stack.
POP X	Pop one element from stack, store result at memory address X .
ADD	Pop the two top most elements from stack, add them and push result on the stack.
MULT	As ADD, but with addition replaced by multiplication.

Assume the stack is initially empty and that the following assembly language program is executed in sequence (A, B, C are main memory addresses):

```
PUSH A
PUSH B
PUSH C
MULT
ADD
POP A
```

Assume further that at memory addresses A, B, C, the following decimal values are stored:

Address	Value
A	10
B	20
C	30

Determine the content of the stack after the execution of each line of this program. Which values are stored at memory addresses A, B, C after the program has been executed?

[6 marks]

- (d) Draw a diagram containing memory data register, instruction register, the register unit, main memory, possible other intermediate registers and the connections used during the execution cycle of the following assembly language instruction:

LOAD Register R1, Register Indirect R2.

Describe the interaction of these devices during the execution cycle. You can assume that the instruction has already been loaded into the instruction register and decoding has taken place.

[10 marks]