OLLSCOIL NA hÉIREANN, CORCAIGH
THE NATIONAL UNIVERSITY OF IRELAND, CORK

COLAISTE NA hOLLSCOILE, CORCAIGH
UNIVERSITY COLLEGE, CORK

2015/2016

Semester 1 - Winter 2015

CS1110: Systems Organization I

Dr Helen Purchase
Professor C. Sreenan
Professor J.P. Morrison

1.5 hours

Attempt all questions.
All Questions Carry Equal Marks.
Total Mark for this Paper is 80.
(For information: Minutes/Mark = 1.125)

SPECIAL REQUIREMENTS
No electronic calculator may be used in this examination

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PLEASE ENSURE THAT YOU HAVE THE CORRECT EXAM PAPER

Question 1

a) Convert 4410_5 (Base 5) to Decimal, Binary, Octal and Hex. Clearly show the methods used to arrive at each answer. (4 marks)

b) Convert the Binary number 10111 to Base 7. Clearly show the methods used to arrive at the answer. (4 marks)

c) Convert the Octal number 123574_8 to Binary. Clearly show the method used to arrive at the answer. (2 marks)

d) Convert the Hex number FACE00F to Binary and to Octal. Clearly show the methods used to arrive at each answer. (4 marks)

e)

1. Support a person types the characters '5', '3' and '6' on a keyboard and presses return. Outline algorithm that could be used to convert this stream of characters into the integer 536?
2. If the ASCII value for the character '0' is 30 hex, what is the sequence of bytes (expressed in hex) coming from the keyboard?
3. What is the minimum number of bits needed to hold the result after converting to the integer representation?

(6 marks)

Question 2

a) Assuming 2's complement representation and just 8 bits, what is the largest positive hex number that can be represented? What decimal number do you get when you add 1 to this hex number? What number do you then get if you negate that decimal number? (6 marks)

b) Show how each of the following can be implemented using only NOR gates:

1. A AND B OR C
2. A XOR B NOT C (8 marks)

c) Draw the Truth-Table for a Half-Subtractor and use it to derive the equations for the Difference and the Borrow. Simplify you equations, if possible, and draw the corresponding circuit diagram. (6 marks)

Question 3

a) Draw a digital logic circuit diagram containing the 3 inputs: A, B and C, such that when C = 0, the output of the circuit is A XOR B and when C = 1, the output of the circuit is AB'. Finally, express this functionality as an equation (6 marks)

b) Draw the circuit diagram for a 4-1 line multiplexor and briefly describe how it works. (6 marks)

c) Show how function M = a'bc + ab'c + abc' could be implemented using an 8-1 line multiplexor. (4 marks)

d) Prove the following using both Algebraic Manipulation and Perfect Induction:
A + (AB) = A (4 marks)

Question 4

a) Derive an equation for *F* from the following Truth-Table. Simplify the function, if possible, and use De Morgan's Theorem to convert it to NAND form only. Draw the corresponding circuit diagram. (8 marks)

A	B	C	*F*
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

b) Draw the circuit D-flip-flop. Using this circuit as a black-box, show how you would construct an 8-bit register and explain how it works.
(8 marks)

c) Name two special-purpose registers and describe their function. (4 marks)