UNIVERSITI TENAGA NASIONAL

College of Information Technology

BACHELOR OF COMPUTER SCIENCE (HONS.)

FINAL EXAMINATION
SEMESTER I 2012/2013

DIGITAL LOGIC DESIGN
(CSNB163)

SEPTEMBER 2012

Time allowed: 3 hours + 10 minutes for reading

INSTRUCTIONS TO CANDIDATES.

1. The total marks for this exam is 100 marks.
2. There are TWO (2) **SECTIONS** to this paper Section A and Section B.
3. Answer **ALL** questions in the answer booklet provided.

DO NOT OPEN THIS QUESTION PAPER UNTIL YOU ARE INSTRUCTED TO DO SO.

THIS QUESTION PAPER CONSISTS OF 8 PRINTED PAGES INCLUDING THIS PAGE.

SECTION A. SHORT ANSWER QUESTIONS. (5 QUESTIONS, 20 MARKS).

<u>Instructions:</u> Answer all questions. Show all your workings.

1. Convert the following number into binary:

   (a) 675_8

   [2 marks]

   (b) 42_{10}

   [2 marks]

2. Perform the following operation:

   (a) $74_8 - 65_8$

   [2 marks]

   (b) $1001011_2 \div 11_2$

   [2 marks]

3. Subtract the octal number below using 2's complement.

   $36_8 - 30_8$

   [4 marks]

4. Describe the difference between half adder and full adder.

   [2 marks]

5. State either the statement below is **TRUE** or **FALSE**

(a) 9's complement is an example of Diminished Radix Complement

(b) Binary logic consists of logic variables and logic operators.

(c) Timing diagram is a graphical representation that describes the relationship between Boolean expression and logic gates in a digital circuit system.

(d) $(x.x) . (x.x)' = 0$

(e) $x+x = 1$

(f) $(x.x') + 1 = x$

[6 marks]

SECTION B. STRUCTURED QUESTIONS. (9 QUESTIONS, 80 marks)

Instructions: Answer all questions.

Question 1

Given the equation $F = AB'C + A'(B + C) + AB(AC + B)$

(a) Derive the **Sum of Minterms** and **Product of Maxterm** from the equation.

[5 marks]

(b) Prove the Sum of Minterms is **equal** to the Product of Maxterm by using the formula F = F''

[3 marks]

(c) Simplified the **Sum of Minterms** equation using Karnaugh Map.

[4 marks]

Question 2

(a) Simplify the Boolean functions below using the theorems and postulates of Boolean Algebra and prove the original equation and the simplified equation is true using truth table.

$X(A, B) = AB(A + B)(B + B)$

[6 marks]

(b) Simplify the Boolean functions below using the theorems and postulates of Boolean Algebra.

$Y(A, B, C, D) = (A + C)(AD + AD) + AC + C$

[4 marks]

Question 3

Draw the logic circuit based of the equation below.

X (A, B, C, D) = AC' + (A+B).(C+D) + AC'D(BC+A')

[4 marks]

Question 4

Draw the circuit diagram necessary for the following problem:

A refrigerator compressor will be triggered ON (1) based on the temperature within the fridge. Whenever the temperature sensor in the fridge detects the temperature in the fridge is higher than the temperature setting sets by the user it will send a signal HIGH (1) that will turn the compressor ON, otherwise the compressor will be OFF to save power.

[3 marks]

Question 5

Draw the circuit for the Boolean equation below and **Convert** all the gates into **NAND** gates.

X(A,B,C,D) =B + A (CD' + B) + (C + D) A

[10 marks]

Question 6

Draw the truth table for the 3-bit **Even Parity Generator** and provide the logic circuit based on the truth table.

[10 marks]

Question 7

(a) Draw the truth table for the **1-bit** binary adder and show the half adder **logic circuit** based on the truth table. (Hint: You need two outputs, Sum and $C_{out.}$).

[6 marks]

(b) Show the **block diagram** for the operation below using full adder.

$111_2 + 111_2$

[8 marks]

Question 8

Complete the truth table below and draw the logic circuit for each output.

A	B	A>B	A<B	A=B

[10 marks]

Question 9

Draw the truth table for **2-to-4 line decoder** with an enable input and complimented outputs. Provide the logic circuit for the decoder.

[7 marks]

---End of Questions---

APPENDIX

Theorems and Postulates of Boolean Algebra

Postulate 2	(a) $x + 0 = x$	(b) $x.1 = x$
Postulate 2	(a) $x + x' = 1$	(b) $x.x' = 0$
Theorem 1	(a) $x + x = x$	(b) $x \cdot x = x$
Theorem 2	(a) $x + 1 = 1$	(b) $x \cdot 0 = 0$
Theorem 3, involution	(a) $(x')' = x$	
Postulate 3, commutative	(a) $x + y = y + x$	(b) $xy = yx$
Theorem 4, associative	(a) $x + (y + z) = (x + y) + z$	(b) $x(yz) = (xy)z$
Postulate 4, distributive	(a) $x(y + z) = xy + xz$	(b) $x + yz = (x + y)(x + z)$
Theorem 5, DeMorgan	(a) $(x + y)' = x'y'$	(b) $(xy)' = x' + y'$
Theorem 6, Absorption	(a) $x + xy = x$	(b) $x(x + y) = x$