UNIVERSITI TENAGA NASIONAL

College of Information Technology

BACHELOR OF COMPUTER SCIENCE (HONS.)

FINAL EXAMINATION
SEMESTER III 2011/2012

DIGITAL LOGIC DESIGN
(CSNB163)

MAY 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 7 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. Do the following conversion:

   (a) 0101010010_2 to decimal.

   [2 marks]

   (b) 88_{10} to octal.

   [2 marks]

   (c) $AB1_{16}$ to binary.

   [2 marks]

2. Subtract the decimal number below using 2's complement binary in 8 bits.

   98 - 23

   [4 marks]

3. Give answers to the following operations:

   (a) $x \oplus x'$

   (b) $x \oplus 1$

   (c) $(x + 1).(x . 0)$

   (d) $(x . 1)'$

   [1.5 marks each]

4. Choose the example of a sum of products expression:

   (a) A + B(C + D) (b) A'B + AC + AB'C

   (c) (A' + B + C)(A + B' C) (d) both (a) and (b)

   [2 marks]

5. Choose the example of Boolean expression written in its canonical form:

   (a) AB + B'C' (b) A'BC' + ABC'+ AB'C

   (c) (A' + B + C)(A + B' + C) (d) both (b) and (c)

   [2 marks]

SECTION B. STRUCTURE QUESTIONS. (8 QUESTIONS, 80 marks)

Instructions: Answer all questions.

Question 1

Simplify the following equation using the theorems and postulates of Boolean Algebra:

(a) $F = AB + (A' + B')C + AB$

[5 marks]

(b) $F = ABCD + AB(C'D') + (AB)'CD$

[5 marks]

Question 2

(a) Simplify the Boolean function below using Karnaugh Map :

$X(\mathrm{A}, \mathrm{B}, \mathrm{C}, \mathrm{D}) = \sum \mathrm{M0}, \mathrm{M2}, \mathrm{M4}, \mathrm{M5}, \mathrm{M7},$

$\mathrm{D}(\mathrm{A}, \mathrm{B}, \mathrm{C}, \mathrm{D}) = \sum \mathrm{M1}\ , \mathrm{M9}, \mathrm{M10}, \mathrm{M11}$

Where "D " indicates Don't care conditions.

[5 marks]

(b) Simplify the truth table below using Karnaugh-map

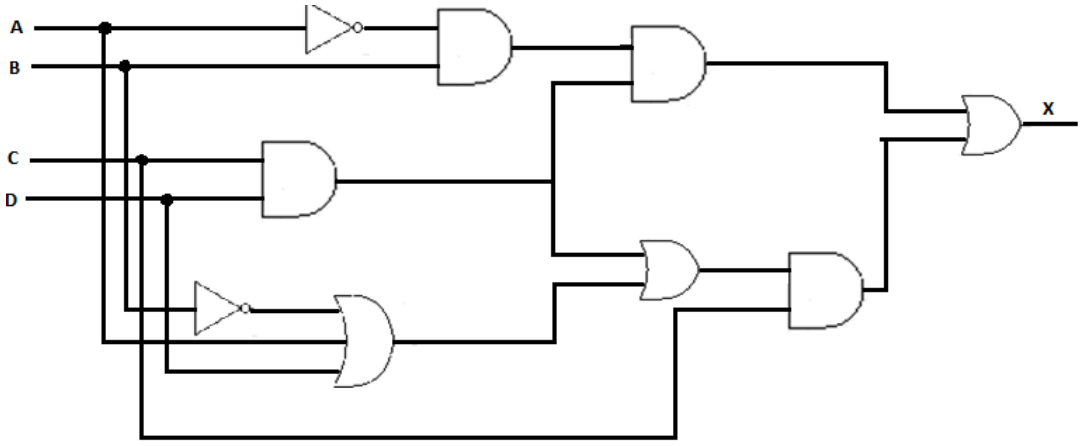
A	B	C	D	Y
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	1
1	1	1	1	0

[5 marks]

Question 3

(a) Derive the Boolean expression of the following circuit diagram.

[5 marks]



(b) Prove the following equation is true using truth table:

$AB + A(B + C) + B(B + C) = B + AC$

[5 marks]

Question 4

(a) Derive the Sum of Minterms **or** Product of Maxterm based on the truth table below

A	B	C	D	F
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0

1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	1
1	1	1	1	1

(b) 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.

[5 marks]

Question 5

Draw the truth table and the circuit that perform the Parity checker using an odd function.

[10 marks]

Question 6

Consider the following binary arithmetic:

101 + 110

(a) Show the logic circuit for the operation above using half adder.

[5 marks]

(b) Show the logic circuit for the operation above using full adder :

[5 marks]

Question 7

(a) Draw the circuit diagram for a 2 bit magnitude comparator and explain briefly what it do.

[10 marks]

Question 8

(a) What is the difference between SR Latched and D Latched?

[5 marks]

(b) Draw the gated SR latched logic diagram.

[5 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) $x(x + y) = x$