UNIVERSITI TENAGA NASIONAL

College of Information Technology

BACHELOR OF COMPUTER SCIENCE (HONS.)

FINAL EXAMINATION

SEMESTER II 2011/2012

DIGITAL LOGIC DESIGN

(CSNB163)

DECEMBER 2011

Time allowed: 2 hours 30 minutes + 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 6 PRINTED PAGES INCLUDING THIS PAGE.

SECTION A. SHORT ANSWER QUESTIONS. (6 QUESTIONS, 30 MARKS).

Instructions: Answer all questions. Show all your workings.

1. Convert the following signed decimal number, - 93, into the following binary representation (in 8 bits):

   (a) sign magnitude

   [2 marks]

   (b) 1's complement

   [1 mark]

   (c) 2's complement

   [2 marks]

2. Convert the binary number $0110\ 0100_2$ into the following representations:

   (a) decimal

   [2 marks]

   (b) hexadecimal

   [2 marks]

   (c) octal

   [2 marks]

3. Do the following decimal arithmetic in its 10's complement form:

   900 - 935

   [4 marks]

4. Find the next **TWO (2)** binary values in this Gray Code sequence.

   00000, 00001, 00011,00010, ..., ...,

   [2 marks]

5. With regards to Boolean expression, distinguish the following terms using examples. (Hint: Just write out the corresponding Boolean expression.)

   (a) Canonical form

   (b) Standard form

   (c) Sum of Products

   (d) Product of Sum

   (e) Sum of Minterms

   (f) Product of Maxterms

[9 marks]

6. For each of the following description, state the Boolean operator (OR, AND, NOT, NAND, NOR or XOR) for the gate:

   (a) The output of this gate is HIGH (1), <u>if and only if</u> all inputs are LOW (0).

[2 marks]

   (b) The output of this gate is HIGH (1), <u>if and only if</u> all inputs are of the same values (e.g. if all HIGH (1) or all LOW (0)).

[2 marks]

SECTION B. STRUCTURED QUESTIONS. (6 QUESTIONS, 70 marks)

Instructions: Answer all questions.

Question 1

(a) Simplify the following Boolean functions using Karnaugh Map :

(i) $F(A,B,C,D) = \overline{ABCD} + \overline{AB}C\overline{D} + \bar{A}BC\overline{D} + A\overline{BCD} + ABCD$

[4 marks]

(ii) $F = xy + \bar{x}yz + \bar{x}z$

$d = \bar{x}y\bar{z} + xyz + x\overline{yz}$, where "d " indicates Don't Care conditions.

[6 marks]

Question 2

(a) Express the following function, F(A, B, C) = ∏ m2, m3, m4, m7, in its Boolean expression form of:

(i) Sum of Minterms

(ii) Product of Maxterms.

[5 marks]

(b) Implement the following function using all NAND gates : F = xy'z + x'y + z

[5 marks]

Question 3

(a) Design a circuit for an even parity generator, *P*, for three input variable *x, y, z*. Show the truth table, the XOR expression and the circuit diagram.

[10 marks]

(b) Give the XOR expression for the corresponding parity checker, *C*, of (a).

[2 marks]

Question 4

A supermarket has an automatic door that opens when someone approaches it. The vicinity of the door is equipped with two sensors placed at varying heights. The door will only opens if the two sensors detect something at the same time, this is to ensure the door only open for human and not wandering pets. There is also a manual button that can be pressed which will open the door regardless of whether anything is detected or not. Assume the door opens on HIGH (1) signal, and the sensors will also be sending a HIGH (1) signal whenever it detects something. Design a logic circuit for such a system. In coming to the answer you must,

(a) show the truth table,

(b) derive the Boolean function using the best form of representation,

(c) simplify if necessary,

(d) and draw the circuit diagram.

[13 marks]

Question 5

Describe the following terms, using diagrams if necessary:

(a) Combinational Circuits

(b) Sequential Logic Circuits

(c) Asynchronous Sequential Logic Circuits

(d) Flip-flops

(e) Latches

[15 marks]

Question 6

(a) Simulate manually the calculation involved in multiplying a 2-bit number by a 2-bit number. Label each bit involved in the partial products and the final products clearly. E.g. 2-bit Multiplicand x 2-bit Multiplier (B1 B2 x A1 A2)

[4 marks]

(b) Draw the necessary circuit diagram that you can use to implement the calculation that you have done to multiply a 2-bit by 2-bit number.

(Hint: You can use two half adders (HA) for the process that can just be illustrated as 

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[6 marks]

---End of Questions---