NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING DEGREE
DURATION 3 HOURS – JANUARY 2013

TEE 2111 DIGITAL ELECTRONICS

INSTRUCTIONS TO CANDIDATES
1. ANSWER **ANY FOUR QUESTIONS ONLY.**
2. ALL QUESTIONS CARRY EQUAL POINTS.
2. SHOW YOUR STEPS CLEARLY IN CALCULATIONS
3. START THE ANSWER FOR EACH QUESTION ON A FRESH PAGE

QUESTION ONE

(a) Convert the decimal number 17983456_{10} into a straight code binary number. [4 points]

(b) Using the method of borrowing subtract 110011111_2 from 1001110000101_2. [6 points]

(c) A logic function **F** = Σ (0, 3, 5, 8, 10, 11, 13, 15) is given.
(i) Write the expression for the function **F** in canonical form;
(ii) Minimize the expression using the Boolean algebra theorems;
(iii) Show how the minimized function can be implemented using 2-input NAND gates only. [15 points]

QUESTION TWO

(a) Convert the octal number 537146_8 into a decimal and a binary number. [6 points]

(b) Divide 111011011101_2 by 1101_2. [6 points]

(c) A logic function **X** = Σ (0, 1, 5, 6, 9, 10, 12, 14, 15). Show how the function can be implemented using:
(i) 16-to-1 Multiplexer;
(ii) 8-to-1 Multiplexer;
(iii) 4-to-1 Multiplexer; [13 points]

QUESTION THREE

(a) Convert the decimal number 0.9734_{10} into a hexadecimal number. [4 points]

(b) Use the 1s complement to subtract 10101110010001_2 from 101001101_2. [6 points]

(c) Show the circuit diagram for a 2-bit comparator implemented on 2-input NAND gates only. [15 points]

QUESTION FOUR

(a) Convert the binary number $1110110001101111001 0_2$ into a hexadecimal number.

[3 points]

(b) Use 2s complement to subtract 11011001.011_2 from 110011101011101.1101_2.

[6 points]

(c) A logic function **E** is given, where **E** = Σ (1, 2 , 5, 7, 8, 9, 11, 14).

(i) Write the expression for the function $\bar{\mathbf{E}}$;

(ii) Minimize the expression using Boolean algebra theorems;

(iii) Obtain an expression for the function **E** from the minimized $\bar{\mathbf{E}}$.

[15 points]

QUESTION FIVE

(a) Convert the decimal number 38954_{10} into an octal number.

[4 points]

(b) Multiply 101100110001_2 by 111010_2.

[5 points]

(c) A logic function **U** = Σ (0, 2, 5, 7, 8, 9, 13, 14) is given. The 12 and 15 states are 'can't happen' states.

(i) Using a Karnaugh map obtain a minimized expression for the function **U** from the function $\bar{\mathbf{U}}$;

(ii) Check the result using the method of 'perfect induction'.

[16 points]

QUESTION SIX

(a) Convert the binary number 1100111011001_2 into a decimal number.

[5 points]

(b) The binary numbers $0111\ 0110\ 0101\ 0011_2$ and $1000\ 1001\ 0111\ 1001_2$ are given in Binary Coded Decimal (BCD) code. Add the two numbers.

[5 points]

(c) Design a 4-input-and-one-output circuit, which is to implement the logic function **Y**. The function is logic '1' when there are only two '1's in the input code and logic '0' in all other cases:

(i) From the truth table, derive an expression for **Y** and minimize it;

(ii) Check your result using the method of 'perfect induction'.

[15 points]