UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE
DEPARTMENT OF PHYSICS

2006
MAIN EXAMINATION

Title of the Paper: **DIGITAL ELECTRONICS**
Course Number: **P411**
Time Allowed: **Three Hours.**

Instructions:
1. To answer, pick any five out of six questions in the following pages.
2. Each question carriers 20 points.
3. This paper has 7 pages, including this page.

DO NOT OPEN THE PAPER
UNTIL PERMISSION HAS BEEN GIVEN BY THE INVIGILATOR.

QUESTION 1:

(a): Transform the Boolean function, $F(A,B,C,D,E) = AB + D\overline{E}$, into

(i). a K-map,

(ii) a function in the following format:

F(A, B, C, D, E)=$\prod$(n1, n2, - - -, nB, nC, - - -, n1F)$_{hex}$

The number in the above brackets must be hexadecimal.

(Hint: Expand this function into canonical form first.). (10 marks)

(b): Perform the subtraction with the following numbers, using any complement. Check the answer by straight subtraction.

(i). 5.25-32.1$_{dec}$.

(ii). 11.01-110.1$_{bin}$ (10 marks)

QUESTION 2:

Using the tabulation method, simplify the following Boolean function F into the SOP answer:

$F(v, w, x, y, z)=\Sigma(0, 4, C, D, E, F, 10, 11, 12, 13, 16, 1E)_{hex}$

(hex number in the brackets of the above function) (20 marks)

QUESTION 3:

(a): With the help of a K-map, obtain the simplified expressions in (i) SOP and (ii) POS of one of the following two Boolean Functions: (you are allowed to choose only one function and obtain the two expressions of the one you picked). In the equations, d is the don't-care conditions.

$$G(A,B,C,D) = \overline{ABC} + A\overline{B}D + \overline{AB}C\overline{D} + A\overline{BD}, \quad d = ABC$$

$$F(A,B,C,D) = (\overline{A} + \overline{B} + D)(A + B + \overline{D})(A + \overline{B} + C + D), \quad d = (\overline{A} + \overline{D})$$

(10 marks)

(b): Implement the Boolean function, $F(A,B,C,D,E) = (A + \overline{B})(ACD + E)$, with only NAND gates and nothing but NAND gates. Complement in-puts are available only at input terminals, nowhere else. The implement must have its support function. (10marks)

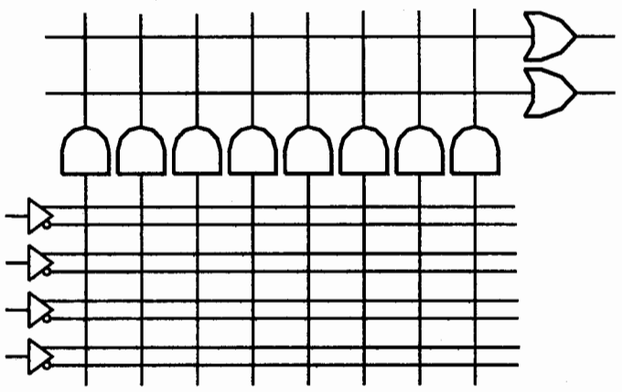
QUESTION 4:

(a): Implement the following function with a multiplexer of 2-bit select address xy (must have this component) and other elementary gates:

$F(v, w, x, y)=\Sigma(0, 1, 3, 5, 8, 9, F)_{hex}$

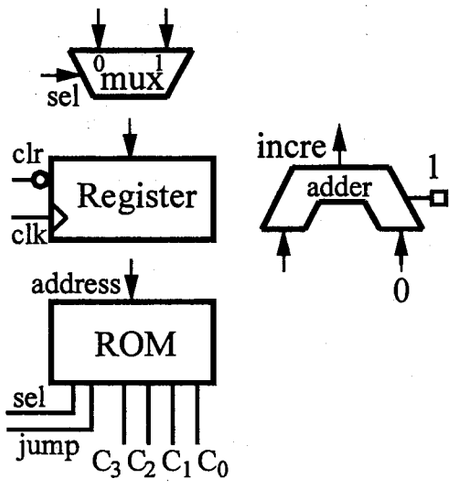
(hex number in the brackets of the above function) (10 marks)

(b): Implement the function given in (a) with a PAL structure. Simplification is required. (10 marks)



QUESTION 5:

(a): In the figure below are components for making a micro-programmed sequencer. In the ROM, there may be fields in a byte: jumping address, "jump"; mux select address, "sel"; and sequence output, "C". Design a sequencer with the components supplied. (10 marks)



(b): Write a ROM program to generate a sequence b,b,2,4,1,c,c,... (repeat). The code is of course from the output C. (10 marks)

ROM Address	ROM Contents		
	sel	jump	output

QUESTION 6:

Design, with D-ff's, a clocked sequencer to cycle repeatedly through the states: 0, 1, 2, 2, 0, 3…(repeat). Obtain a logic circuit, a state table, a state diagram, and ff input functions. (Hint: need a hidden unit) (20 marks)