UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE
DEPARTMENT OF PHYSICS

2006/2007
SUPPLEMENTARY 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.

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UNTIL PERMISSION HAS BEEN GIVEN BY THE INVIGILATOR.

QUESTION 1:

a: Transform the K-Map below into (10 marks)

(1). a Truth Table,

(2). a function in the following format (a SOP):

$F_1(B, C, D, E) = \Sigma(n1, n2, - - -, nB, nC, - - -, nF)_{hex}$

(3). a function in the following format (a POS):

$F_2(B, C, D, E) = \prod(n1, n2, - - -, nB, nC, - - -, nF)_{hex}$

The number in the above brackets must be hexadecimal.

b: Prove $F_1 = F_2$. (must have equations to support) (10 marks)

BC \ DE	00	01	11	10
00	**1**	**1**		**1**
01		**1**	**1**	
11		**1**		
10	**1**	**1**		**1**

QUESTION 2:

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

$F(v, w, x, y, z) = \Sigma(0, 4, 9, B, D, F, 12, 13, 16, 17, 19, 1B, 1D, 1F)_{hex}$

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

QUESTION 3:

a: With the help of a K-map, obtain the simplified expression of the Boolean Function below in both SOP and POS. (10 marks)

$F(A,B,C,D,) = \overline{A}(\overline{B}\overline{D} + CD + BC)$

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

b: Implement the Boolean function,

$F(A,B,C,D,E) = (ACD + E)(A + \overline{B}) + BC\overline{D}E$,

with only NOR gates and nothing but NOR gates. Complement inputs are available only at input terminals, nowhere else. The implement must have its function support. (10 marks)

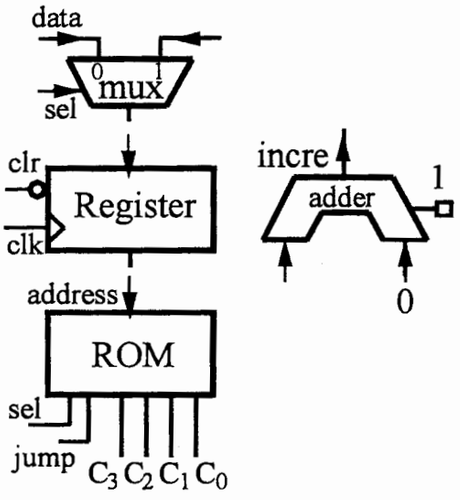
QUESTION 4:

a: Implement the following function with a multiplexer of 4-1 (must have this component) and other elementary gates. Assign xy as the address of the MUX. (10 marks)

$F(v, w, x, y)= \Sigma(1, 3, 7, 8, 9, A, D, F)_{hex}$

(hex number in the brackets of the above function)

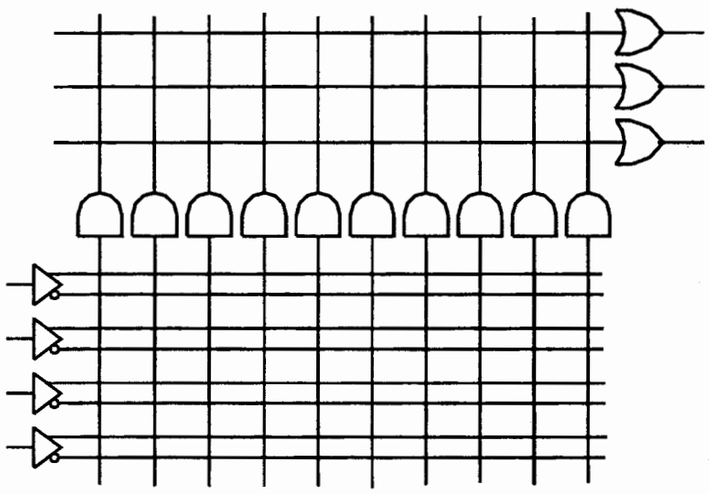
b: In the figure below is a micro-programmed sequencer (the circuit is not complete yet). In the ROM, there are fields in a byte: jumping address, mux select address, and sequence output, C. First, complete the circuit wiring to make the sequencer have a proper function as listed in the ROM table. Next, fine the sequence C that the processor runs through; the sequencer starts at address 0000 and finally jumps back to 0000. (10 marks)



ROM addr	ROM contents		
	sel	jump	C
0	1	x	A
1	1	x	2
2	0	A	4
3	1	x	7
4	1	x	C
5	1	x	F
6	1	x	9
7	0	0	4
8	1	x	1
9	1	x	3
A	0	E	E
B	1	x	5
C	1	x	D
D	1	x	0
E	0	6	0
F	0	0	6

QUESTION 5:

Design a sorting circuit for two 2-bit codes, B_1B_0 and A_1A_0. Compare two codes to find out "B>A"; ie, F=1, when B>A. Design the circuit to fit in a PLA. Simplification is required. The circuit must have its function support. (hint, using logical inference, or an abridged truth table. A simplification identity $(X + \overline{X}Y) = X + Y$). (20 marks)



QUESTION 6:

Design, with D-ff's, a clocked sequencer to cycle repeatedly through the states: - - - 0, 1, 3, 7, 5, 2, - - -. Not-used states must be properly treated. Obtain a state diagram, a state table, ff input functions, and finally a logic circuit. Does this sequencer need a hidden unit? (20 marks)