UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE
DEPARTMENT OF
ELECTRICAL and ELECTRONIC ENGINEERING

July 2014
SUPPLEMENTARY EXAMINATION

Title of the Paper: **Digital Systems I**
Course Number: **EE322**
Time Allowed: **Three Hours.**

Instructions:
1. To answer, pick Q1, Q2 & any others to sum a total of 100% from questions in the following pages.
2. The answer is better neatly written in the space provided in the question book. Use the answer book as a scratch pad.
3. Must use the map and the table provided.
4. This paper has 7 pages, including this page.

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

Compulsory for Q1 and Q2:

Q1. 10% Name and write down any two flip-flops and their associated state characteristic equations.

Q2. 10% With the flip-flops as a block diagram, RS or JK, draw a circuit of one bit binary counter and one bit memory.

Free to Choose for the Following Questions:

Q3. 10% Convert the following numbers from the given base to the bases indicated:

(a). hexadecimal 115.22 to base 4 and decimal

(b). decimal 91.7 to hexadecimal and binary

Q4. 10% Perform the subtraction with the following numbers using any complement. What is the total system number of digits? Check the answer by straight subtraction.

(a). $160-1600_{dec}$ (b). $10.101-101.1_{bin}$

Boolean Function Fundamentals:

Q5a 15% Transform the Boolean function below,

$F(A,B,C)=\overline{A}(B+AC)+(\overline{A}+B)C$,

into:

(i). Equation in SOP form, $F_s=\Sigma(---)_{hex}$, (ii). K-Map,
(iii). Equation in POS form, $F_p=\prod(---)_{hex}$, (iv). Truth table

$F_s=\Sigma($ $)_{hex}$,

$F_p=\prod($ $)_{hex}$,

Q5b 5% prove $F_p=F_s$

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

AB-C	0	1
00		
01		
11		
10		

Q6 10% Create a 4-bit reflected (Gray) code from the start byte, 1001.

9	1001		

Simplification:

Q7 10% With the help of a K-map, obtain the simplified expressions in (1) SOP, F_s and (2) POS, F_p of the following Boolean Function. Can you claim F_s=F_p and explain why?

$$F(A,B,C) = A(C+\overline{B}) + \overline{ABC}$$

AB-C	0	1
00		
01		
11		
10		

Q8 20% With the help of a K-map, obtain the simplified expressions in (1) SOP, F_s and (2) POS, F_p of the following Boolean Function, where d is the don't care case. Can you claim F_s=F_p and explain why?

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

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

AB-CD	00	01	11	10
00				
01				
11				
10				

Combinational Logic Circuit:

Q9 20% Implement the Boolean function below with only NOR gates and nothing but NOR gates, yet complement inputs are available only at input terminals, nowhere else. The implementation must have its function support.

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

Q10 20% A mechanical switch is shown in Fig. Q10-1. In the graph is a 2-pole and 2-throw switch; the two poles are gauged of course. Convert this mechanical switch into electronic circuit. (hint: consider the switch and two inputs as independent variables and the two outputs as two Boolean functions)

SAB	F1	F2	SAB	F1	F2
000			100		
001			101		
010			110		
011			111		

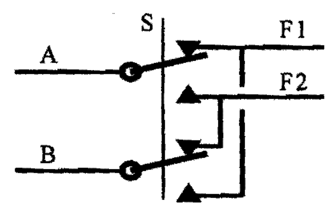

Fig. Q10-1

Q11 20% Design a 9-compliment circuit.

$A_8A_4A_2A_1$	$C_8C_4C_2C_1$
0000	
0001	
0010	
0011	
0100	
0101	
0110	
0111	
1000	
1001	