Department of CSIT

Information Technology

FINAL PROJECT

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Problem 1

1.

Design a digital logic circuit (all steps are required), using minimal amount of gates, that will realize a digital logic circuit corresponding to the following *A097803 polynomial* :

$$A = 3(2x^2 + 1), \textit{ with input } (x) : 0 \leq (x) \leq 7$$

(a) Set–up the truth–table

[Binary inputs: (x); Binary outputs: $A_1, A_2, A_3, A_4, ...$]

	X1	X2	X3	A	A1	A2	A3	A4	A5	A6	A7	A8	A9
0	0	0	0	3	0	0	0	0	0	0	0	1	1
1	0	0	1	9	0	0	0	0	0	1	0	0	1
2	0	1	0	27	0	0	0	0	1	1	0	1	1
3	0	1	1	57	0	0	0	1	1	1	0	0	1
4	0	0	0	99	0	1	1	1	0	0	0	1	1
5	0	0	1	153	0	0	0	0	1	1	0	0	1
6	0	1	0	219	0	1	1	0	1	1	0	1	1
7	0	1	1	297	1	0	0	1	0	1	0	0	1

(b) Derive the output expressions

A1 = x1x2x3

A2 = x1x2'x3 + x1x2x3'

A3 = x1x2'x3' + x1x2x3'

A4 = x1'x2x3 + x1x2'x3' + x1x2x3

A5 = x1'x2x3' + x1'x2x3 + x1x2'x3 + x1x2x3'

A6 = x1'x2'x3 + x1'x2x3' + x1'x2x3 + x1x2'x3 + x1x2x3' + x1x2x3

A7 = 0

A8 = x1'x2'x3' + x1'x2x3' + x1x2'x3' + x1x2x3'

(c) Simplify (optimally) the derived expressions, USING ONLY K–Maps

A1

	00	**01**	**11**	**10**
0	0	0	0	0
1	0	0	1	0

A2

	00	01	11	10
0	0	0	0	0
1	0	1	0	1

A3

	00	**01**	**11**	**10**
0	0	0	0	0
1	1	0	0	1

A4

	00	**01**	**11**	**10**
0	0	0	1	0
1	1	0	1	0

A5

	00	**01**	**11**	**10**
0	0	0	1	1
1	0	1	0	1

A6

	00	**01**	**11**	**10**
0	0	1	1	1
1	0	1	1	1

A7

	00	**01**	**11**	**10**
0	0	0	0	0
1	0	0	0	0

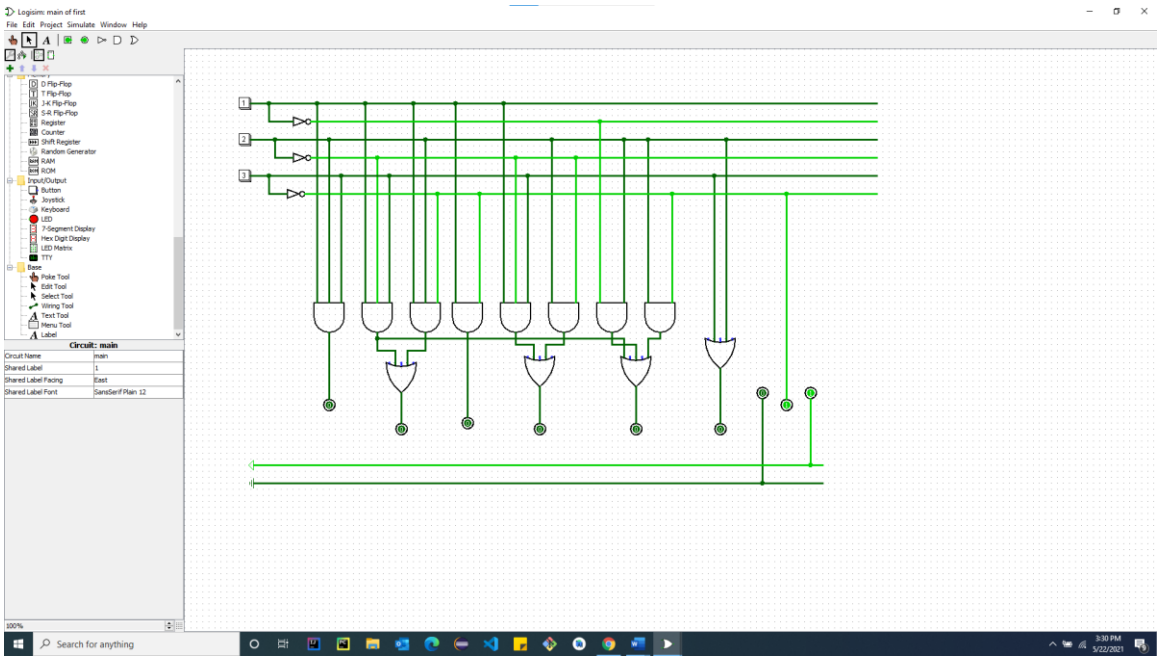
A8

	00	**01**	**11**	**10**
0	1	0	0	1
1	1	0	0	1

A9

	00	**01**	**11**	**10**
0	1	1	1	1
1	1	1	1	1

(d) Implement the simplified digital logic circuit, using *LogiSim*.



Problem 2

2. Design a Read Only Memory (ROM) to implement the following, *A097803*, polynomial

$$A = 3(2x^2 + 1), \textit{ with input } (x) : 0 \leq (x) \leq 7$$

(a) What is the size of the initial (unsimplified) ROM ?

Knowing that it is a ROM we need 4-8 decoders and 16 or gates are needed.

(b) What is the size of the final (simplified) ROM ?

When the input X = 0

-> 3(2*(0)^2 + 1)

= 0

The same thing goes on when X = 1,2,3,4,5,6,7,8

X= 1

= 3(2*(1)^2 + 1)
= 9

X=2
= 3(2*(2)^2 + 1)
= 27

X = 3
= 3(2*(3)^2 + 1)
= 57

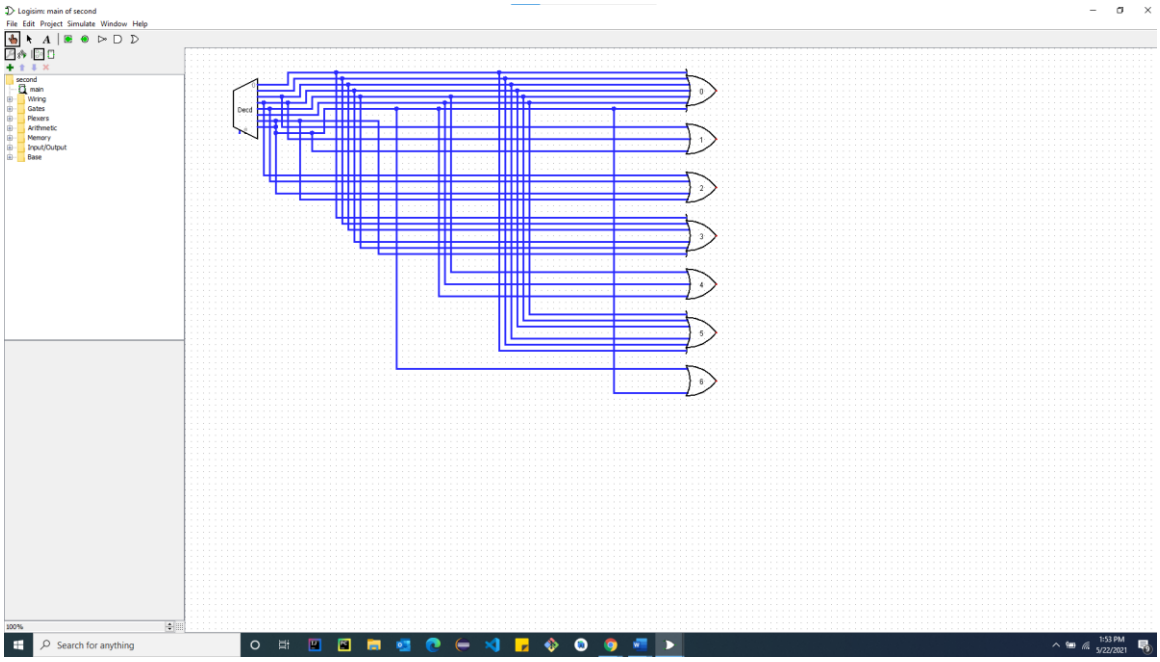
X = 4
= 3(2*(4)^2 + 1)
= 99

X =5
=3(2*(5)^2 + 1)
= 153

X = 6
= 3(2*(6)^2 + 1)
=219

X = 7
= 3(2*(7)^2 + 1)
= 297

(c) Show in detail the final ROM layout, using *LogiSim*.



Problem 3

3.

Using MIPS assembly–language evaluate the following, *A097803*, polynomial:

$$A = 3(2x^2 + 1), \textit{ for } x = 0, 1, 2, 3, 4, 5, 6, 7$$

(a) The program should be simple modularized and well–documented

(b) Appropriate comments in the program are necessary

(c) Place the results, in the command line window (console). In the report include a clear screenshot of the DECIMAL results (command line window–console area) and the REGISTERS with the DECIMAL results

(registers area)

(d) Indicate if the program runs successfully according to specifications and clearly state the results (DECIMAL numbers).

```
.data

pr1: .asciiz # formula A= 3(2*x^2+1)
newline: .asciiz#print new line
pr2: .asciiz #The Program run successfully
re1: .asciiz

.text
.globl main

main:
li $v0, 4 #call for string for 1
la $a0, pr1 #String being stored
syscall

li $v0, 4 # call for new line instructions
la $a0, newline #  string being stored
syscall

li $t0, 0 #storing 0 in $t0
li $t1, 7 #storing 7 in $t1

startingloop:

mul $t2, $t0, $t0 #square root
mul $t2, $t2, 2 #multiplying 2 into t2
add $t2, $t2 1 #adding 1 into t2
mul $t2, $t2, 3 #multiplying  3 into t2
li $v0, 4 #call for print string 1
la $a0, re1 #address of string
syscall
```

```
li $v0, 1 #print new line integer
move $a0, $t2 #move t2 to a0
syscall

add $t0, $t0, 1 # 1++ incrementation
ble $t0,$t1,startingloop #loop

#finaloop

li $v0, 4 #call for new line
la $a0, newline #String loaded
syscall

li $v0, 4 #printing node 2
la $a0, pr2 #string location in register
syscall

li $v0, 10 #exit
syscall
```