Ryerson University
Department of Electrical and Computer Engineering
COE 608–Computer Organization and Architecture

Midterm Test **March 6, 2018**

Name: _____ **Student Number:** _____ **Sec:**----------

Time limit: 1 hour 50 min Examiners: N. Mekhiel

Notes:
a) Closed book.
b) No calculators.
c) Answer all questions **in the space provided.** Total Marks= 40

Q1- Assume the following C code :-

```
for(i=0; i<=2000; i++) {
                X[i] =9*Y[i]+ X[i];
              }
```

Assume that $S0 has the address of X[0] and $S1 has the address of Y[0] and i is in $S2.

1.1-(5 Marks) Write the above code using MIPS instructions.

=5

Each mistake -1

```
addi $S2, $0, 0;      i = 0
addi $S3, $0, 2001;   limit = 2001
Loop: sll $S4, $S2, 2;    4i
add $S5, $S4, $S0;        &X[i]
add $S6, $S4, $S1;        &Y[i]
lw $T0, 0($S5);           X[i]
lw $T1, 0($S6);           Y[i]
mul $T2, $T1, 9;          9 Y[i]
add $T3, $T2, $T0;        9 Y[i] + X[i]
sw $T3, 0($S5);           X[i] = 9 Y[i] + X[i]
addi $S2, $S2, 1;         i+1
slt $S8, $S2, $S3;        i < 2001
bnez $S8, Loop
```

1.2 (2 Marks) How many instructions are executed during running this code.

=2

$N = 11 \times 2001 + 2 = 22,003$

Name:_______________________ Section:________

1.3 (3 Marks) Find the performance of above code in MIPS 1 GHz processor assuming that arithmetic instruction takes 1 cycle, data transfer instruction takes 4 cycles, conditional branch takes 2 cycles and jump takes 1.2 cycle.

Data

$T = ((7\times1 + 3\times4 + 1\times2)\,2001 + 2\times1)\,1\,ns = 42023\,ns$

$= 42\,\mu s$

each mistake = −1

Total = 3

1.4 (5 Marks) Find performance of the system if using 4 processors and only 80% of above code could run in parallel

$\frac{.8\times42}{4} + .2\times42\ \mu s = 16.8\,\mu s$

Total = 5

speedup = $\frac{1}{\frac{.8}{4} + .2} = 2.5$ 3

$T = \frac{42}{2.5} = 16.8\,\mu s$ 2

1.5(5 Marks) Rewrite the code to optimize performance by replacing the multiplication operation 9*Y[i] with faster instructions

addi $2, $0, 0

Loop: —

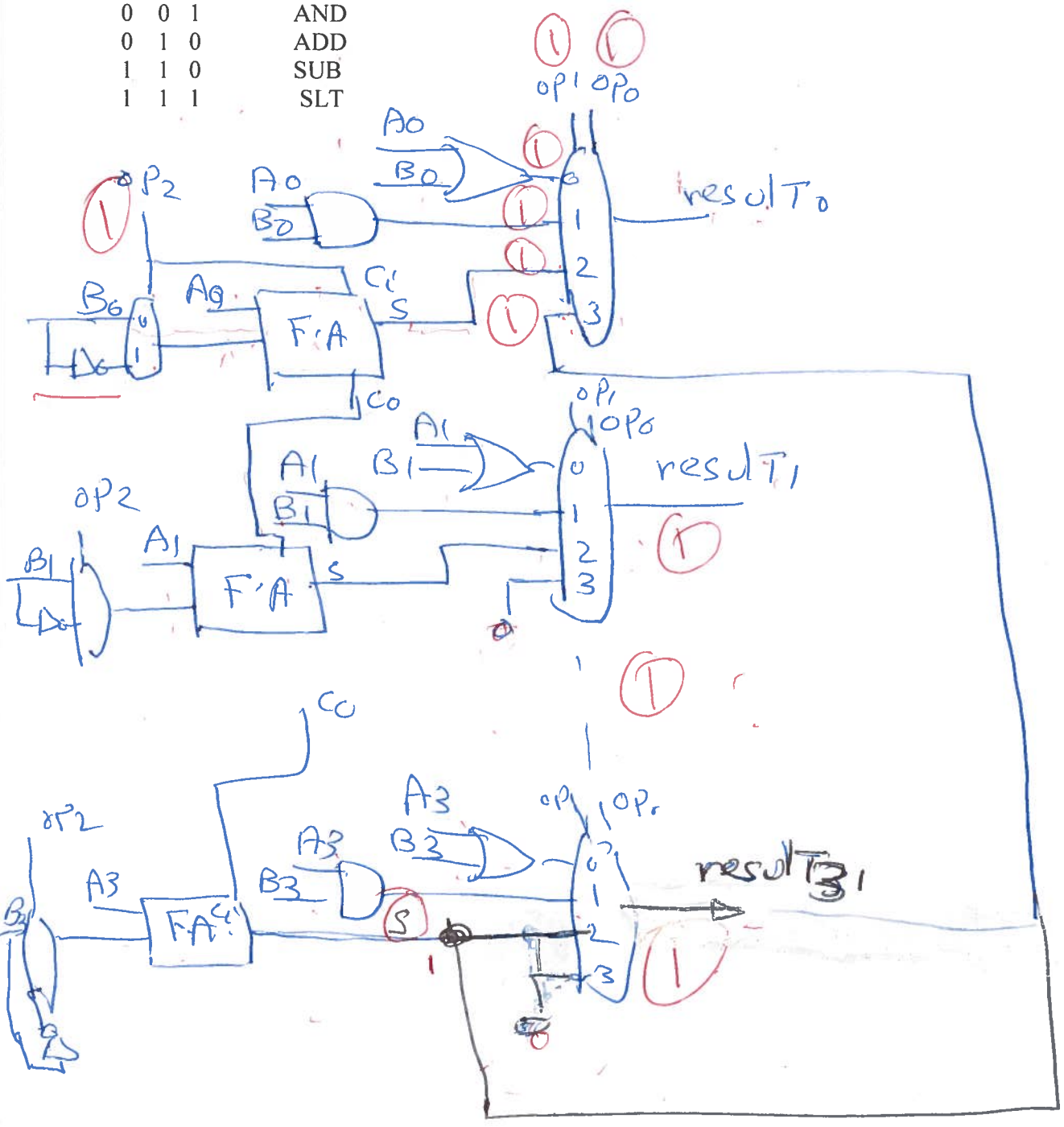
sll T4, T1, 3 ; 8 Y[i]
add T4, T4, T1 ; 9 Y[i]

5

Name:_____ Section:_____

Q2.1 (10 Marks) Design a 4 bit ALU that performs the following operations based on op2,op1,op0 as:-

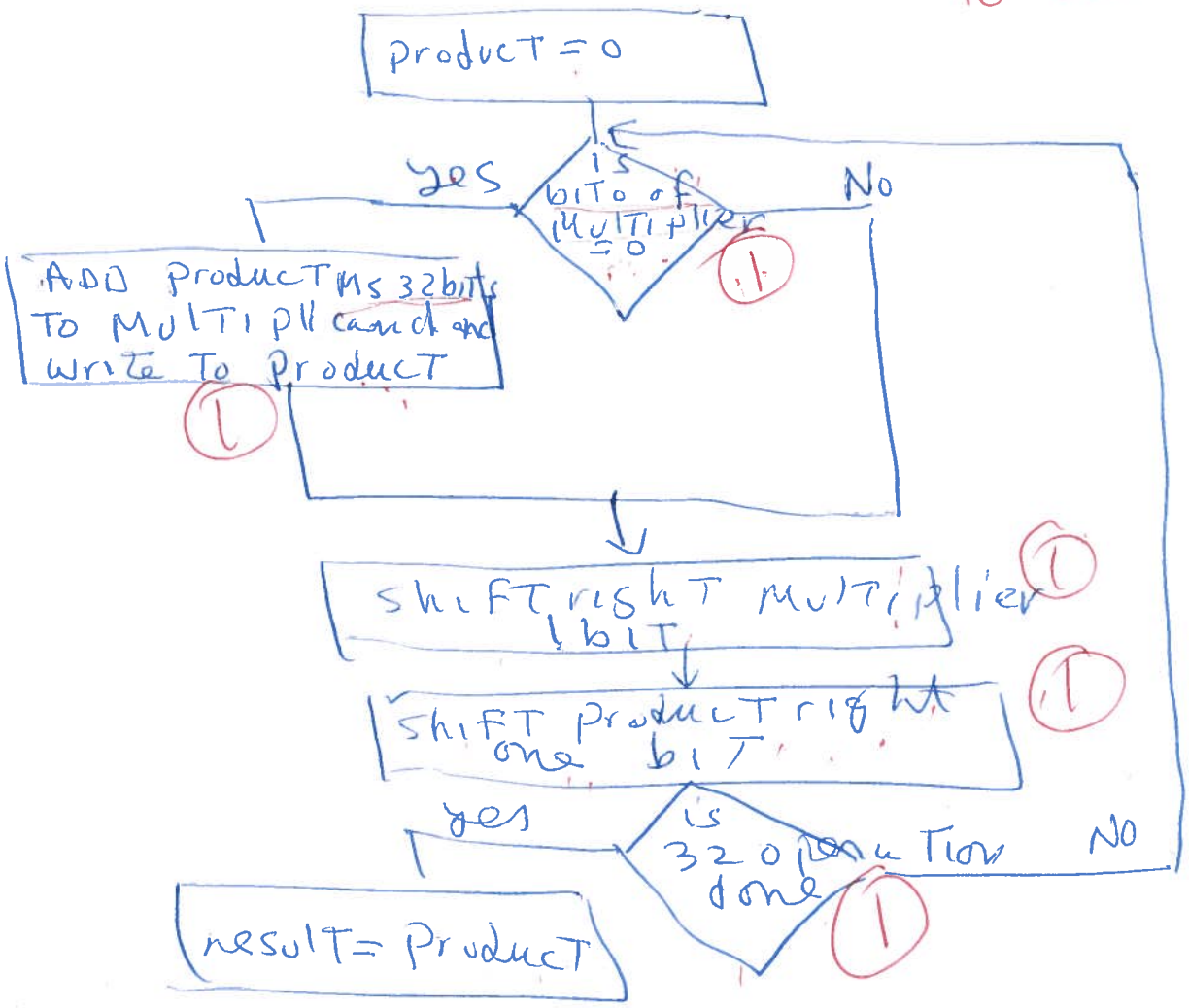
op2	op1	op0	operation
0	0	0	OR
0	0	1	AND
0	1	0	ADD
1	1	0	SUB
1	1	1	SLT



Name:_____ Section:_____

Q2.2 (5 Marks) Draw a **FLOW CHART** for a 32 bit simple Multiplication Algorithm that uses a 32 bit ALU

To Tal = 5



Q2.3- (5 Marks) Determine the value of the following binary number If it is IEEE754 FP:-

11000011001010000000000000000000

E = 10000110 = 134 (1)

S = - ve (1)

F = .0101 (1)

N = $-1.0101 \times 2^{134-127}$ (1)

$= -1.0101 \times 2^{7} = -168$ (2)