**CS2100 Computer Organisation**

**AY2021/22 Semester 1**

**Assignment 2 Answer Sheet**

|  |  |
| --- | --- |
| **FULL NAME:** | **Toh Jia-Yih Ronald** |
| **STUDENT ID:**  E.g., <AxxxxxxxY> | **A0199937B** |
| **TUTORIAL GROUP:** | **T02** |

**Question 0.** **Submission instructions (3 marks)**

|  |  |
| --- | --- |
| 1. Name your file with your student number (eg: AxxxxxxxY>.pdf). (1 mark) | **Y** |
| b. Submit your assignment as a single PDF file. (1 mark) | **Y** |
| c. Your submission has your tutorial group number, student number and name. (1 mark) | **Y** |

**Question 1. Datapath (8 marks)**

|  |  |
| --- | --- |
| **Field** | **Value** |
| RegDst | X |
| MemRead | 0 |
| MemWrite | 1 |
| ALUSrc | 1 |
| RegWrite | 0 |
| Instruction[31-26] \* | 0b 101011 |
| Instruction[25-21] \* | 0b 11101 |
| Instruction[20-16] \* | 0b 10010 |
| Instruction[15-11] \* | 0b 11111 |
| Instruction[5-0] \* | 0b 11000 |
| ➊ \* (output from sign-extend) | 0x FFFF FFD8 |
| ➋ \* | 0x 0000 0000 |
| ➌ \* | 0x 0000 00A4 |
| ➍ \* (read data 2) | 0x 0004 0200 |
| ➎ \* | 0x 7FFF F01E |
| ➏ (ALU control output) | 0010 |

**Question 2. Simplification (14 marks)**

(a) *B*⋅*Y*⋅*E’*⋅(*A'*⋅*X* + *A*⋅*X'* + *A*⋅*X* + *A’*⋅*X'*)+ *B’*⋅*L*⋅*U*⋅*E’*⋅*S’*⋅*K*⋅*Y* + *Y*⋅*E'*⋅*S'* [6 marks]

|  |  |
| --- | --- |
| B⋅Y⋅E’⋅ (1) + B’⋅L⋅U⋅E’⋅S’⋅K⋅Y + Y⋅E’⋅S’ | Complement Law |
| B⋅Y⋅E’ + B’⋅L⋅U⋅E’⋅S’⋅K⋅Y + Y⋅E’⋅S’ | One Element Law |
| B⋅Y⋅E’ + Y⋅E’⋅S’⋅(B’⋅L⋅U⋅K + 1) | Distributive Law |
| B⋅Y⋅E’ + Y⋅E’⋅S’ | One Element Law |
| Y⋅E’⋅(B + S’) | Distributive Law |

(b) (c)

*D*

*B*

*A*

*C*

***G***

*D*

*B*

*A*

*C*

***F***

0 X 1 0 0 0 1 1

0 X 1 1 X 0 0 1

0 X 0 1 X 0 X 1

0 X 1 0 1 X X 1

[4 marks] [4 marks]

|  |  |
| --- | --- |
| #PIs | 6 |
| #EPIs | 3 |
| Simplest SOP | A⋅B’ + B’⋅C + C⋅D’ |
| Simplest POS | (A+C)⋅(B’+D’) |

|  |  |
| --- | --- |
| #PIs | 4 |
| #EPIs | 3 |
| Simplest SOP | B⋅C⋅D’ + A’⋅D + B’⋅D |
| Simplest POS | C⋅(B+D’)⋅(A’+B’+D’) |

**Question 3. Circuit Design (8 marks)**

(a) [2 marks]

*EE*

*C*

*B*

*D*

*A=0*

X

X

X

X

X

X

1

X

1

1

1

0

0

1

1

0

*EE*

*C*

*B*

*D*

*A=1*

0

1

1

0

0

1

1

1

0

1

1

0

0

1

1

0

(b) Write out the simplified SOP expression for *M*. [3 marks]

E + A’⋅C⋅D’ + A⋅C⋅D

c) Draw the circuit for *V*. [3 marks]

XNOR

|  |
| --- |
| A |
| D |
| C |
| E |
| B |

OR

V

\*Labelling xnor and or in case drawing is too bad .\_.

**Question 4. Block-level design (7 marks)**

(a) *F*(*A*,*B*,*C*,*D*) = m(1, 4, 5, 6, 7, 13) [3 marks]

**2-bit**

**COMP**

*X*<*Y*

*X*=*Y*

*X*>*Y*

*X*

1

0

*Y*

1

0

B

D

A

F

C

(b) *G*(*A*,*B*,*E*) = m(3,5)

*H*(*A*,*B*,*E*) = m(1,2,4,6) [4 marks]

H

**HA**

*X*

*Y*

*S1*

*C1*

B

**HA**

*X*

*Y*

*S2*

*C2*

A

E

G

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A | B | E | G | H | C1 | S1 | C2 = S1·E = G | S2 = A⊕B⊕E | H = A⊕B⊕E⊕C1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |

(Add more columns to the table if there are insufficient columns.)