IN1006 Systems Architecture (PRD1 A 2022/23)

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State	Finished
Completed on	Thursday, 1 December 2022, 6:23 PM
Time taken	12 mins 17 secs
Grade	**10.00** out of 10.00 (**100**%)

Question **1**

Correct

Mark 1.00 out of 1.00

Consider the following MARIE code. What does this code do?

```
If,     Load X
        Subt Y
        Skipcond 400
        Jump Else
Then,   Load X
        Add X
        Output
        Jump Endif
Else,   Load Y
        Subt X
        Store Y
Endif,  Halt
X,      Dec 10
Y,      Dec 5
```

Select one:

a. It will store the octal value 5 and terminate.

b. It will compute the decimal value -5, store it in Y and terminate. ✔

c. It will store the hexadecimal value -5 in the memory address X and terminate.

d. It will output the hexadecimal value -5 and terminate.

e. It will compute and store the decimal value 5.

This program executes an "If, then, else" statement using the Skipcond instruction. In this case, the condition in Skipcond is 01. So, PC will become PC+1 if AC=0 and the "Then" part of the code will be executed. If AC <> 0 then the "Else" part of the code will be executed. After the execution of the first two statements, AC will be 5, so the "Else" part of the code will be executed. So the program will compute Y-X=-5, store this value in Y and terminate.

The correct answer is: It will compute the decimal value -5, store it in Y and terminate.

Question **2**

Correct

Mark 1.00 out of 1.00

Which of the following statements is *the most accurate* description for the sum-of-products expression below?

F = A'BC + ABC' + AB'C'

Select one:

- a. Don't know/no answer.
- b. The truth table has two rows where F = 1 and no zeros need to be in the inputs to return one.
- c. The truth table has three rows where F = 1 and at least one zero must be in the inputs to return one. ✔
- d. The truth table has three rows where F = 1 and B must be one to return one.
- e. The truth table has three rows where F = 1 and no zeros need to be in the inputs to return one.
- f. The truth table has four rows where F = 1 and no zeros need to be in the inputs to return one.

Your answer is correct.

The number of OR-ed terms above specifies the number of input cases that lead to a true expression (rows of truth table that give F = 1). Each of the inverted variables shows where the input needs to be zero for that input case.

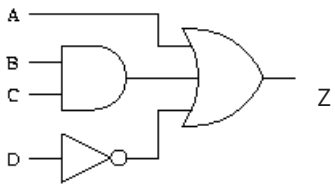
The correct answer is: The truth table has three rows where F = 1 and at least one zero must be in the inputs to return one.

Question **3**

Correct

Mark 1.00 out of 1.00

Which of the following is the correct Boolean expression for the logic circuit below (with output Z).



Select one:

- a. Z = A + (B+C)D'
- b. Z = A' + (BC) + D'
- c. Z = A + (B•C) + D' ✔
- d. Don't know/no answer
- e. Z= A + (BC) + D

Input D feeds directly into a NOT gate so is inverted to D'. Inputs B and C are AND-ed together. Then all are OR-ed together with A to give the expression:

$$Z = A + (BC) + D'$$

The correct answer is: Z = A + (B•C) + D'

Question **4**

Correct

Mark 1.00 out of 1.00

Which of the following equations correctly reflects the truth table shown below? A,B and C are inputs and F is the output.

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

Select one:

- a. F = A'BC' + A'BC + AB'C' + ABC' + ABC ✔
- b. F = AB'C + A'BC' + A'BC' + A'B'C + A'B'C'
- c. Don't know/no answer
- d. F = (AB'C + A'BC' + A'BC' + A'B'C + A'B'C')'
- e. None of these expressions
- f. F = (A'BC ' + A'BC + AB'C' + ABC' + ABC)'

Your answer is correct.

The F output is given as a sum-of-products expression where each product (AND) should correspond to a row where F = 1.

The correct answer is: F = A'BC' + A'BC + AB'C' + ABC' + ABC

Question **5**

Correct

Mark 1.00 out of 1.00

What is the effect of a bitwise-OR operation on the following 12-bit words: 1000 1010 1101, 0110 1110 0101?

Select one:

- a. Don't know/no answer
- b. 0000 1100 0101
- c. 0001 0001 0010
- d. 1110 0100 1000
- e. 1111 0011 1010
- f. 1110 1110 1101 ✔

The OR operation is applied to each of the pairs of bits at the same position in each word, moving from left to right.

The correct answer is: 1110 1110 1101

Question **6**

Correct

Mark 1.00 out of 1.00

What is the difference when executing instructions `LOAD x` and `LOADI x` ?

Select one:

- a. LOAD x loads the value of MBR to AC; LOADI loads the value of MAR to AC.
- b. LOAD loads the value at address x to the AC; LOADI loads the value x to the AC
- c. LOAD loads the value x to the AC; LOADI loads the value found at x to the AC
- d. LOAD loads the value at address x to the AC; the LOADI loads the value found in the location addressed by the value in x to the AC ✔
- e. There is no difference if x is the current value of MBR

LOAD x loads the value of the memory word with address x to the AC whereas LOADI x loads the value of the memory word whose address is the value of the memory word with address x to the AC.

The correct answer is: LOAD loads the value at address x to the AC; the LOADI loads the value found in the location addressed by the value in x to the AC

Question **7**

Correct

Mark 1.00 out of 1.00

Which MARIE instruction is being carried out by the following microoperations?

$$MAR \leftarrow Y$$
$$MBR \leftarrow AC$$
$$M[MAR] \leftarrow MBR$$

Select one:

- a. STORE AC+MAR
- b. LOAD Y
- c. STORE Y ✔ Correct
- d. ADD Y
- e. Neither the above sequence nor any subsequence of it corresponds to a MARIE instruction.

Your answer is correct.

The first microoperation assigns Y to MAR. The second microoperation assigns the value of AC to MBR, and the last microoperation stores the value of MBR to the memory word with the address indicated by MAR. Hence given microoperations correspond to the MARIE instruction STORE Y.

The correct answer is: STORE Y

Question **8**

Correct

Mark 1.00 out of 1.00

Consider the following MARIE program. What is the outcome of the program?

```
            Clear
            Add X
LoopC,      Skipcond 800
            Jump LoopEnd
Loop,       Output
            Subt Y
            Jump LoopC
LoopEnd,    Halt
X,          Dec 5
Y,          Dec 1
```

Select one:

- a. The program will output the decimal numbers 5, 4, 3, 2 and 1 before ending. ✔
- b. The program will compute the expression 5 + 4 + 3 + 2 +1 (i.e., 15) before ending.
- c. The program will do nothing.
- d. The program will output the decimal numbers 5, 4, 3, 2, 1 and 0 before ending.
- e. The program will compute the expression 5 - 4 - 3 -2 -1 (i.e., - 5) before ending.

This program executes a "Loop" using the Skipcond instruction. In this case, the condition in Skipcond is set to 10 and so IR[11-10] is 10. Thus, if AC>0 then PC will become PC+1 and the execution will continue from "Loop" . Otherwise, the execution will continue from "LoopEnd". Initially (after the execution of the first two statements) the AC will be 5 (>0) and thus the instruction at the position "Loop" will be executed outputing 5 (i.e., the current value of AC). Then 1 will be subtracted from AC and the execution will continue from LoopC (due to the "Jump LoopC" instruction). This time the AC will be 4 so the evaluation of Skipcond will make the program continue from "Loop" again, this time outputing 4 first and then subtracting 1 from it. This will continue until AC becomes 0, at which point the program execution will jump to "LoopEnd" and will be halted. Thus, the program will output the values 5, 4, 3, 2 and 1 before halting.

The correct answer is: The program will output the decimal numbers 5, 4, 3, 2 and 1 before ending.

Question **9**

Correct

Mark 1.00 out of 1.00

Consider the following MARIE program. What is the outcome of the program?

```
            Load X
            Store Sum
LoopC,      Skipcond 800
            Jump LoopEnd
Loop,       Subt Y
            Store W
            Add Sum
            Store Sum
            Load W
            Jump LoopC
LoopEnd,    Halt
X,          Dec 4
Y,          Dec 1
Sum,        Dec 0
W,          Dec 0
```

Select one:

- a. The program will output the values 4, 3, 2, 1 and 0 before ending.
- b. The program will halt immediately after reaching the Skipcond instruction for the first time.
- c. The program will compute the expression 4+2+0 before ending.
- d. The program will compute the sum 4+3+2+1+0 before ending.
- e. The program will compute the sum 4+3+2+1+0 and store it in Sum before ending. ✔

This program executes a "Loop" using the Skipcond instruction. In this case, the condition in Skipcond is set to 10 and so IR[11-10] is 10. Thus, if AC>0 then PC will become PC+1 and the execution will continue from "Loop" . Otherwise, the execution will continue from "LoopEnd". Initially (after the execution of the first two statements) the AC will be 4 (>0) and the value 4 will be stored in Sum. Thus the instruction at the position "Loop" will be executed subtracting 1 from AC, adding its value to Sum and storing the updated value to Sum (this will make the value of Sum equal to 7, i.e., 4+3). Then the execution will continue from LoopC (due to the "Jump LoopC" instruction). This time the AC will be 3 so the evaluation of Skipcond will make the program continue from "Loop" again, this time subtracting 1 first from AC and then adding its value (i.e., 2) to Sum. This will continue until AC becomes 0, at which point the program execution will jump to "LoopEnd" and will be halted. Thus, the program will find the sum of values 4+3+2+1+0 and store it in the memory position Sum before halting.

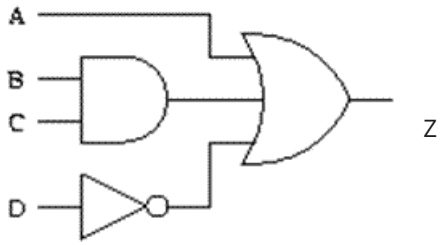
The correct answer is: The program will compute the sum 4+3+2+1+0 and store it in Sum before ending.

Question **10**

Correct

Mark 1.00 out of 1.00

Given the logic circuit and table below, which line of the table does ***not*** correspond with the behaviour of the logic circuit (with output Z)?



Row	A	B	C	D	Z
1	0	0	0	0	1
2	0	0	0	1	0
3	0	0	1	0	1
4	0	0	1	1	0
5	0	1	0	0	1
6	0	1	0	1	0
7	0	1	1	0	1
8	0	1	1	1	1
9	1	0	0	0	1
10	1	0	0	1	1
11	1	0	1	0	1
12	1	0	1	1	1
13	1	1	0	0	1
14	1	1	0	1	1
15	1	1	1	0	0
16	1	1	1	1	1

Select one:

- a. Row 10
- b. Row 1
- c. Row 11
- d. Row 6
- e. Don't know/no answer
- f. Row 7
- g. Row 13
- h. Row 3
- i. Row 15 ✔

Row 15 is in error as since A is an input to the final OR-gate and Z should be one when A is one.

The correct answer is: Row 15

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