Solution and Marking

Section 1: Fill in the Blanks [40 marks]

Solutions:

Q 1.1 CPU, Memory, I/O [**3 marks**]
Q 1.2 5 or 7. Correctly answer one of them, 2 marks; both correct, 3 marks
Q 1.3 $xy' + z$ [**3 marks**]
Q 1.4 -60 [**2 marks**];
1100 0100 [**2 marks**]
Q 1.5 $BC'D' + A'C'D + AB'D$ [**3 marks**]
Q 1.6 0000000C [**3 marks**]
Q 1.7 28; 4; $s0; $t0 [**4 marks**]
Q 1.8 subu $s2, $0, $s1 [**3 marks**]
Q 1.9 $s3, $s3, $0, $0 [**4 mark**]
Q 1.12 11, 01 [**4 marks**]

Section 2: MIPS [30 marks]

Q 2.1 Solution:

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MIPS program code to be completed:

li $t0,0
for1:
li $t1, 0
li $t2, 0
lw $t3, 0($a1)
move $t4, $a2

for2:
lw $t5, 0($t4)
[bne] $t3, $t5, skip  # 1 mark
addiu $t1, [$t1], [1]  # 2 mark, can change order

skip:
addiu $t4, [$t4], [4]  # 2 mark, can change order
addiu $t2, [$t2], [1]  # 2 mark, can change order
bne $t2, [$a0], [for2] # 2 marks

sw $t1, 0($a3)
addiu $a1, [$a1], [4]  # 2 mark, can change order
addiu $a3, [$a3], [4]  # 2 mark, can change order
addiu $t0, $t0, 1 # i++
bne $t0, [$a0], [for1]  # 2 marks
```

Q 2.2 Solution:

Function: this program will compute the sum of the decimal digits. [**5 marks**]

For example: suppose the unsigned integer 1121 is stored in **$a0**, the result is $1+1+2+1=5$, which will be stored in **$v0**. [**5 marks**]

Section 3: MIPS

Q 3.3 Solution:

(a) $A = S_1'S_0'D_0 + S_1'S_0D_1 + S_1S_0'D_2 + S_1S_0D_3$. [**3 marks**]

(b) For A: $S_1 = x, S_0 = y, D_0 = z, D_1 = z', D_2 = z', D_3 = z$.
Substitute into above question, we get $A = x'y'z + x'yz' + xy'z' + xyz$ [**3 marks**]
Then, $A = \Sigma(m_1, m_2, m_4, m_7)$ or $A = \Sigma(1, 2, 4, 7)$. [**1 marks**]

For B: $S_1 = x, S_0 = y, D_0 = 0, D_1 = z, D_2 = z, D_3 = 1$.
$B = x'yz + xy'z + xy$ or $B = x'yz + xy'z + xyz + xyz'$ [**3 marks**]
Then $B = \Sigma(m_3, m_5, m_6, m_7)$ or $B = \Sigma(3, 5, 6, 7)$. [**1 marks**]

(c) The circuit implements a 1 bit full adder (or addition operation). [**2 marks**]
A is the SUM, B is the carry forward bit. [**2 marks**]

Q 4.1

(1) 3 pts

x_3	x_2	x_1	Y_1	Y_0	highest index
0	0	0	1	1	3
0	0	1	1	1	3
0	1	0	1	1	3
0	1	1	1	1	3
1	0	0	1	0	2
1	0	1	1	0	2
1	1	0	0	1	1
1	1	1	0	0	0

(2) 4pts

Y_1 :

x_3 \ x_2x_1	00	01	11	10
0	1	1	1	1
1	1	1	0	0

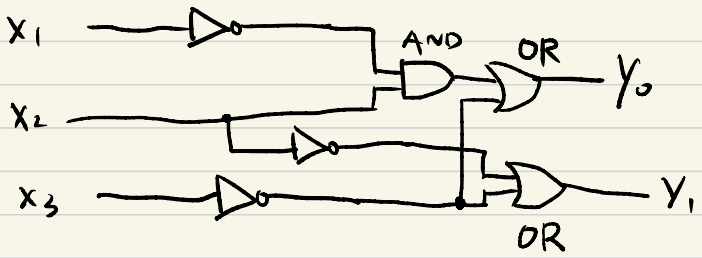
$Y_1 = x_3' + x_2'$

Y_0 :

x_3 \ x_2x_1	00	01	11	10
0	1	1	1	1
1	0	0	0	1

$Y_0 = x_3' + x_1'x_2$

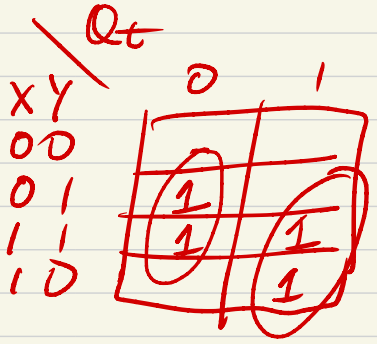
(3) 3pts



Q6.

(1)

X	Y	Q_t	Q_{t+1}
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1



$$Q_{t+1} = X Q_t + Y Q_t'$$

(2) Excitation table

Q_t	Q_{t+1}	X	Y
0	0	x	0
0	1	x	1
1	0	0	x
1	1	1	x

(3) Given J-K : $Q_{t+1} = J Q_t' + K' Q_t$

compare to $Q_{t+1} = X Q_t + Y Q_t'$

$\Rightarrow$ $J = Y$, $K = X'$ ..... (2pts)