Question Mapping with Course Outcomes:

Item	COs	POIs	K	P	A	Marks	Obtained Marks
Q1-2	CO1	P.a.4.C.3	K4			5+5	
					Total:	10	

Student Information:

Student Name:	Solve Sheet												Section:	O

Student ID #:	2	3	-	4	6	7	0	9	-	1	Date:	13.12.2023	Department:	
	p	q	-	a	b	c	d	e	-	r				

1. Determine the control words of the following micro-operations both in decimal and hexadecimal forms. **[5]**

   Replace a-e and p-r with the digits of your student ID number. If the digit is more than 7 then replace that digit by 7.

Micro- Operation	Control Word in Binary	Control Word in Hexadecimal
$Ra \leftarrow Rp + Rq + C_{in}$ $R4 \leftarrow R2 + R3 + C_{in}$	0b010 011 100 001 1 000	0x4E18
$Rr + Rb$ $R1 + R6$	0b001 110 000 001 0 000	0x3810
$Rc \leftarrow$ crc Rd $R7 \leftarrow$ crc $R0$	0b001 001 111 100 0 101	0x27C5
$Re \leftarrow$ shl Rr $R7 \leftarrow$ shl $R1$	0b001 001 111 100 0 010	0x27C2

2. Determine the remaining output bits of the ROM and the next address of the ROM location based on the following input and output data. **[5]**
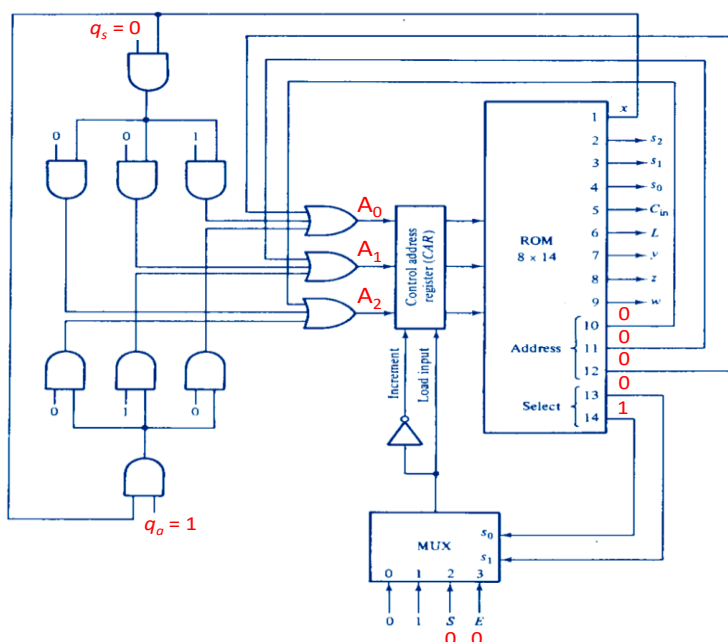
Answer:

At the initial state, $x = 1$; since $q_a = 1$, there is an arithmetic operation, so, $s_2 = 0$. Besides, this is an addition operation, as such, $s_1 = 0$, $s_0 = 1$, and $C_{in} = 1$. After the addition operation, the output and C_{out} must be loaded in the registers (A and E), so $L = 1$, $y = 0$, $z = 0$, and $w = 0$. The input to the multiplexer's selector (s_1s_0) is 01, so 1 (the 2nd input of the 4:1 multiplexer) is transferred to its output, as such the address (010) at the CAR's input will be loaded to its output. The next address generator circuit generates an address of 010 to be loaded into the CAR. This is shown in the next figure.

ROM
8 × 14

Control Address register (CAR)

A_0 A_1 A_2

Increment

Load input

Address

Select

MUX

s_0 s_1

0 1 2 3

0 1 S E

q_s

q_a

1 x
2 s_2
3 s_1
4 s_0
5 C_{in}
6 L
7 v
8 z
9 w
10
11
12
13
14