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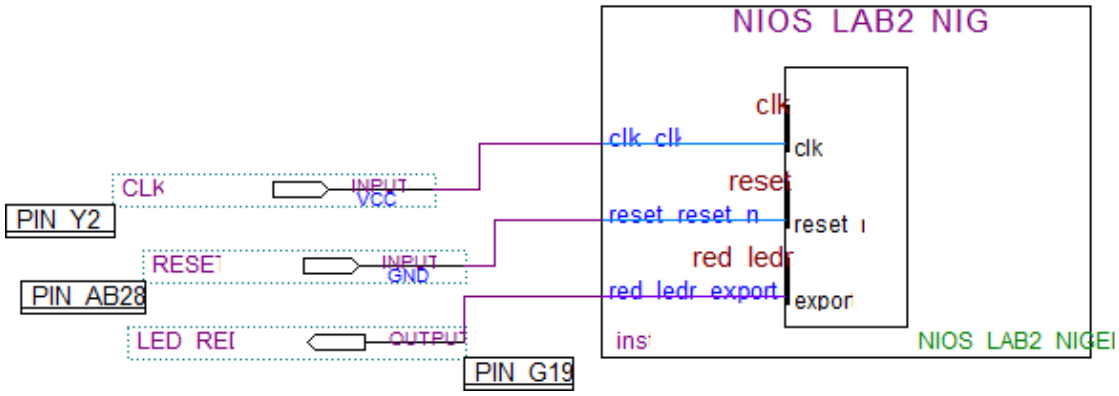
Date: 14/3/2023
Lab 2, ECE3073

Lab 2 – Monash University Malaysia, Sem 1 2021 – Sheet

1. Screen shot of the NIOS – II microcomputer system with one LED interface, with no errors and labels of pin numbers are visible and paste the assembly code to light the LED ON. (4 marks)



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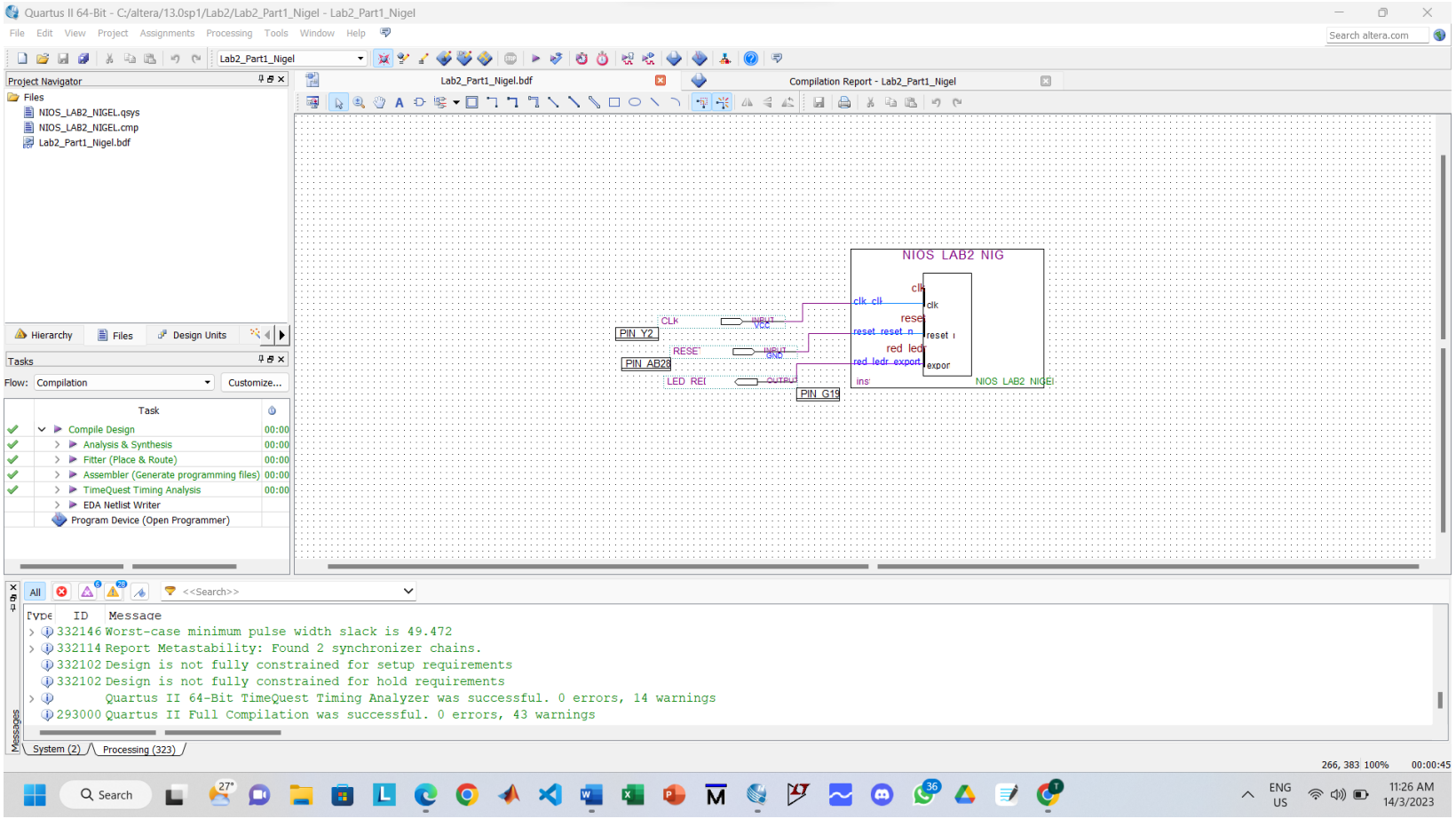

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CODE

```
.global _start
_start:

movia r3, 0x2000
loop:   movia r4, 0x01
        stwio r4, 0(r3)
        br loop
```

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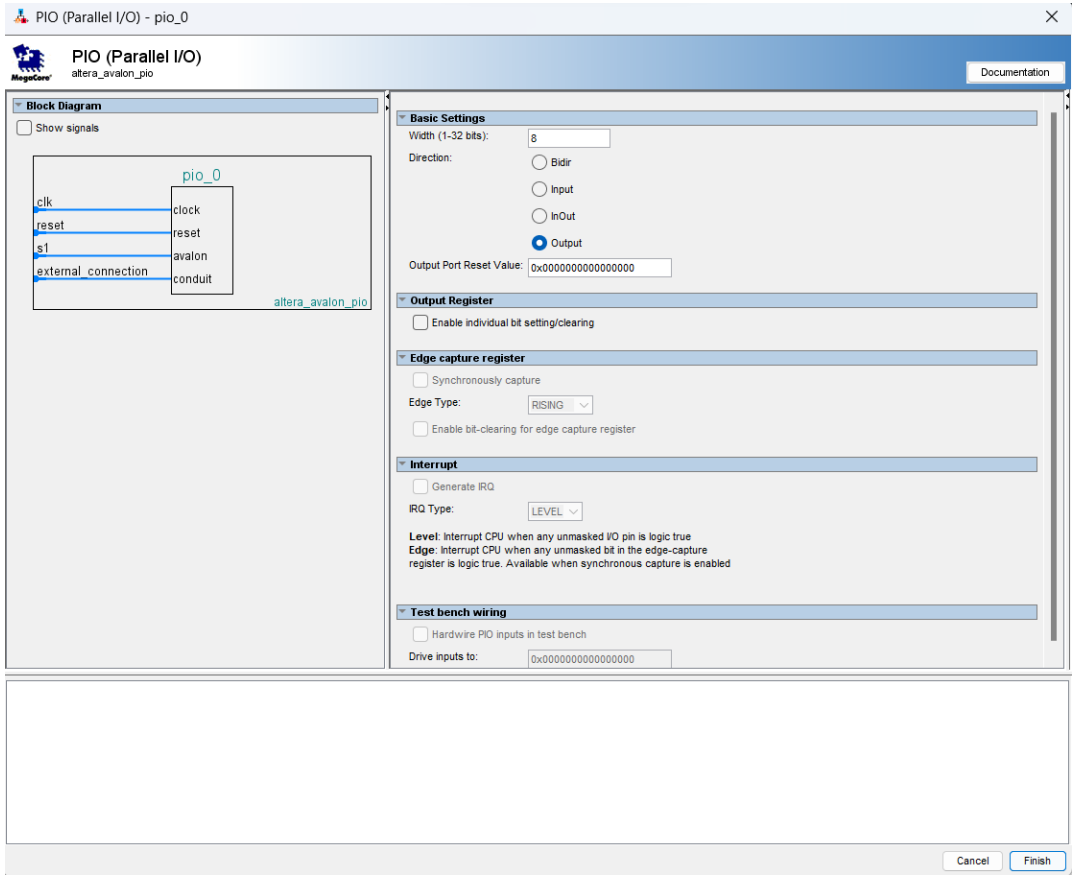
2. Qysys screen shot showing PIO for 8- LEDs, and screen shot of the schematics, type the code for lighting up 8 red LEDs. (3 marks)



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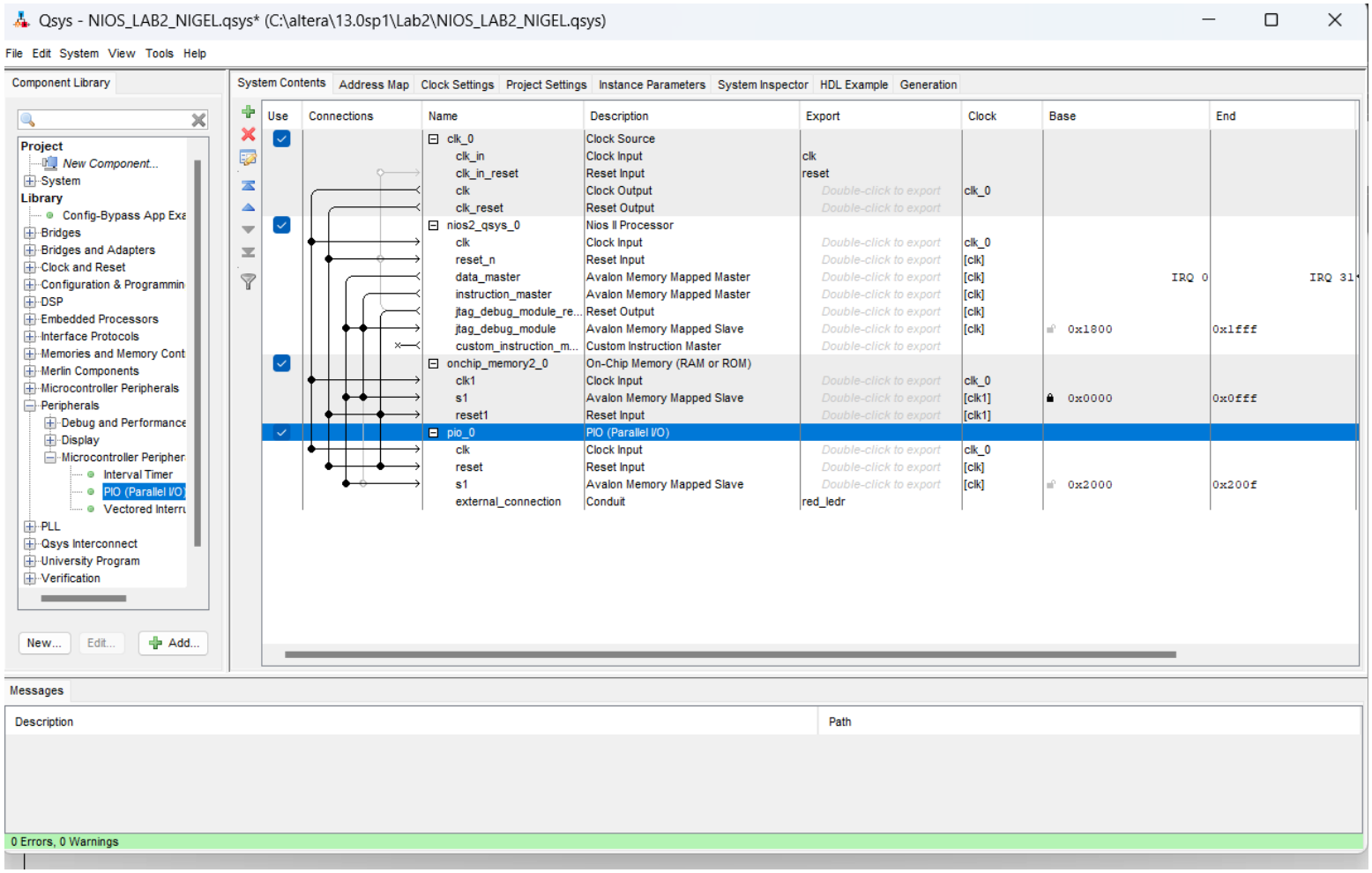

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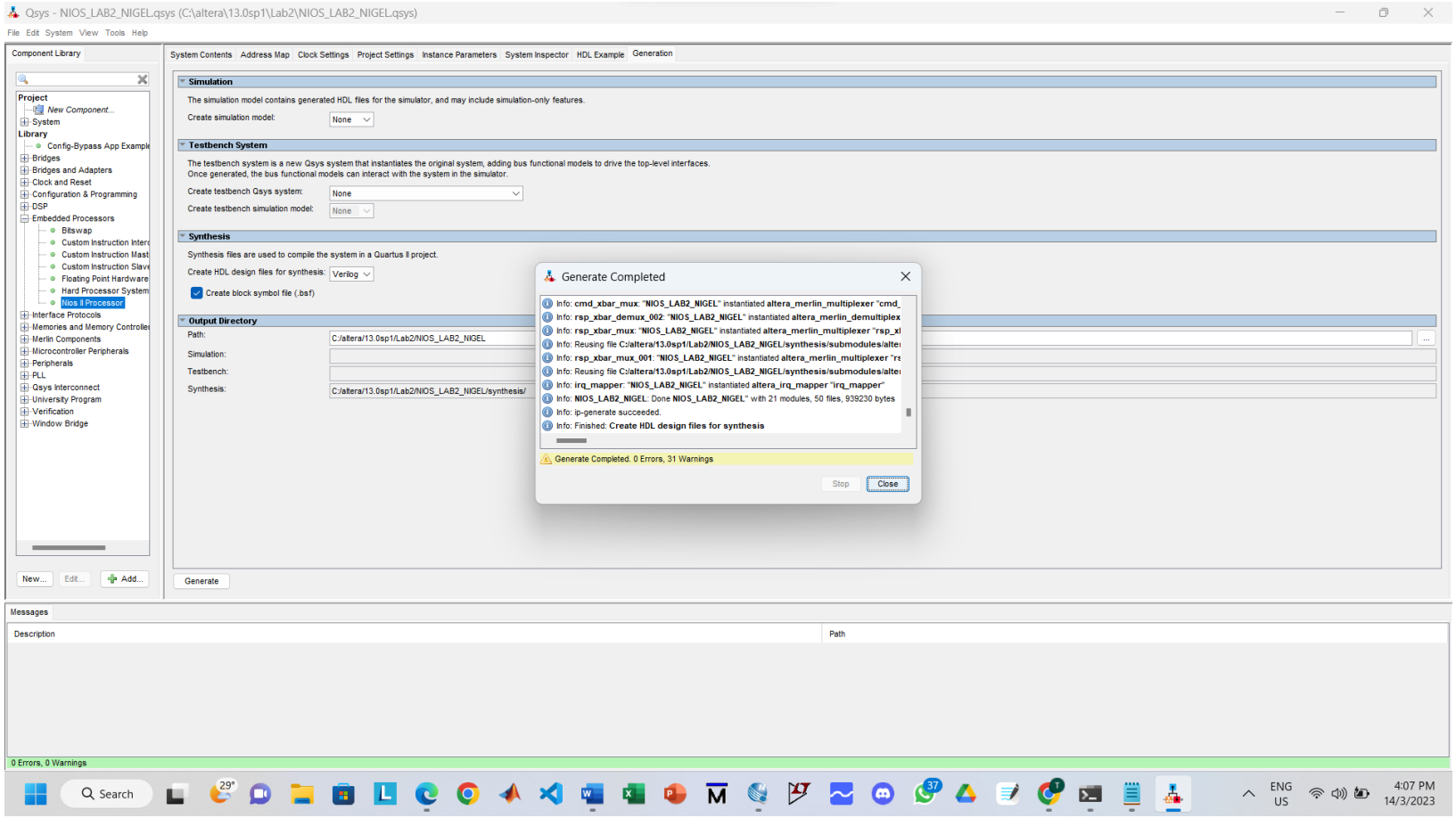

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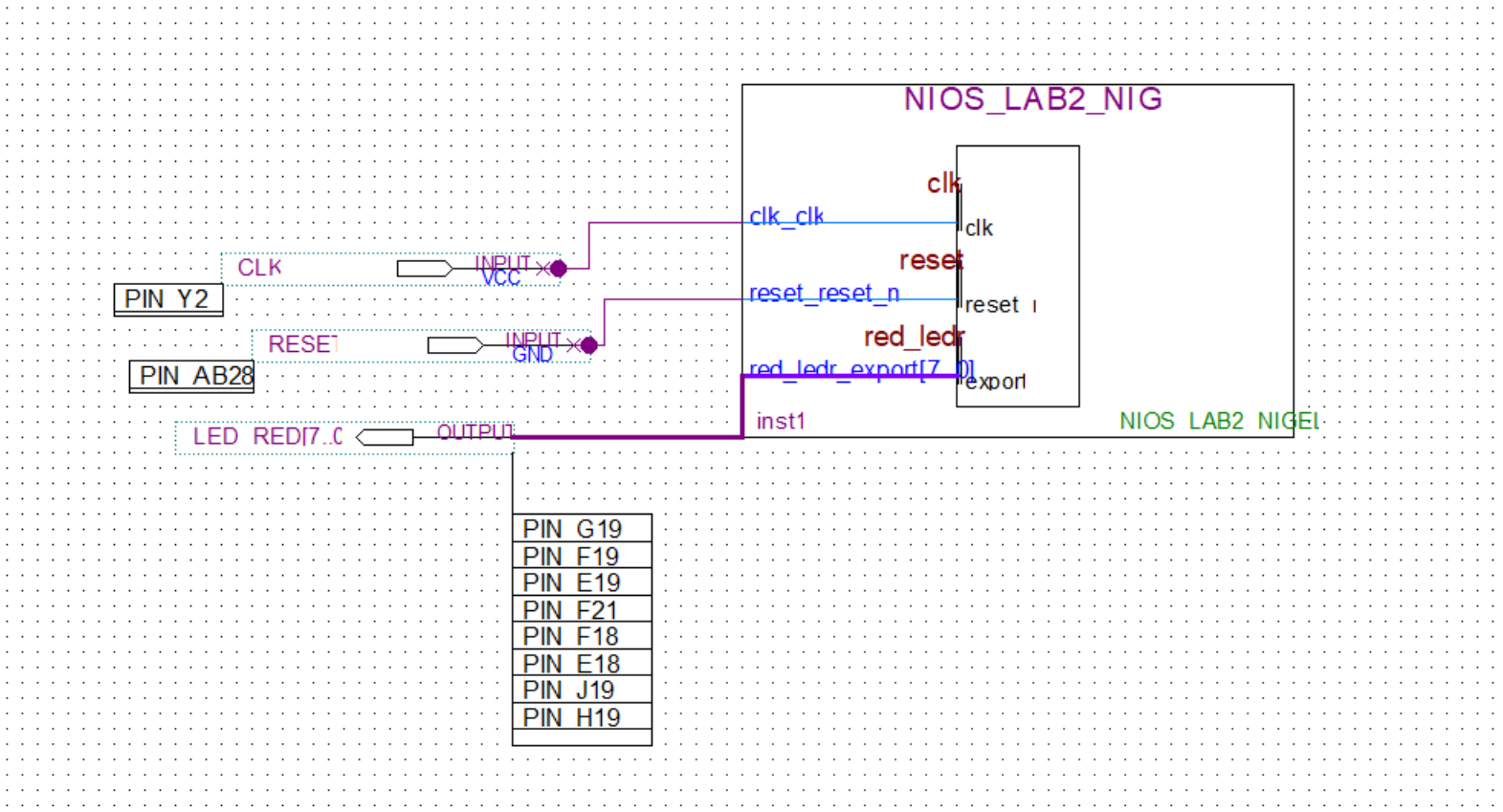

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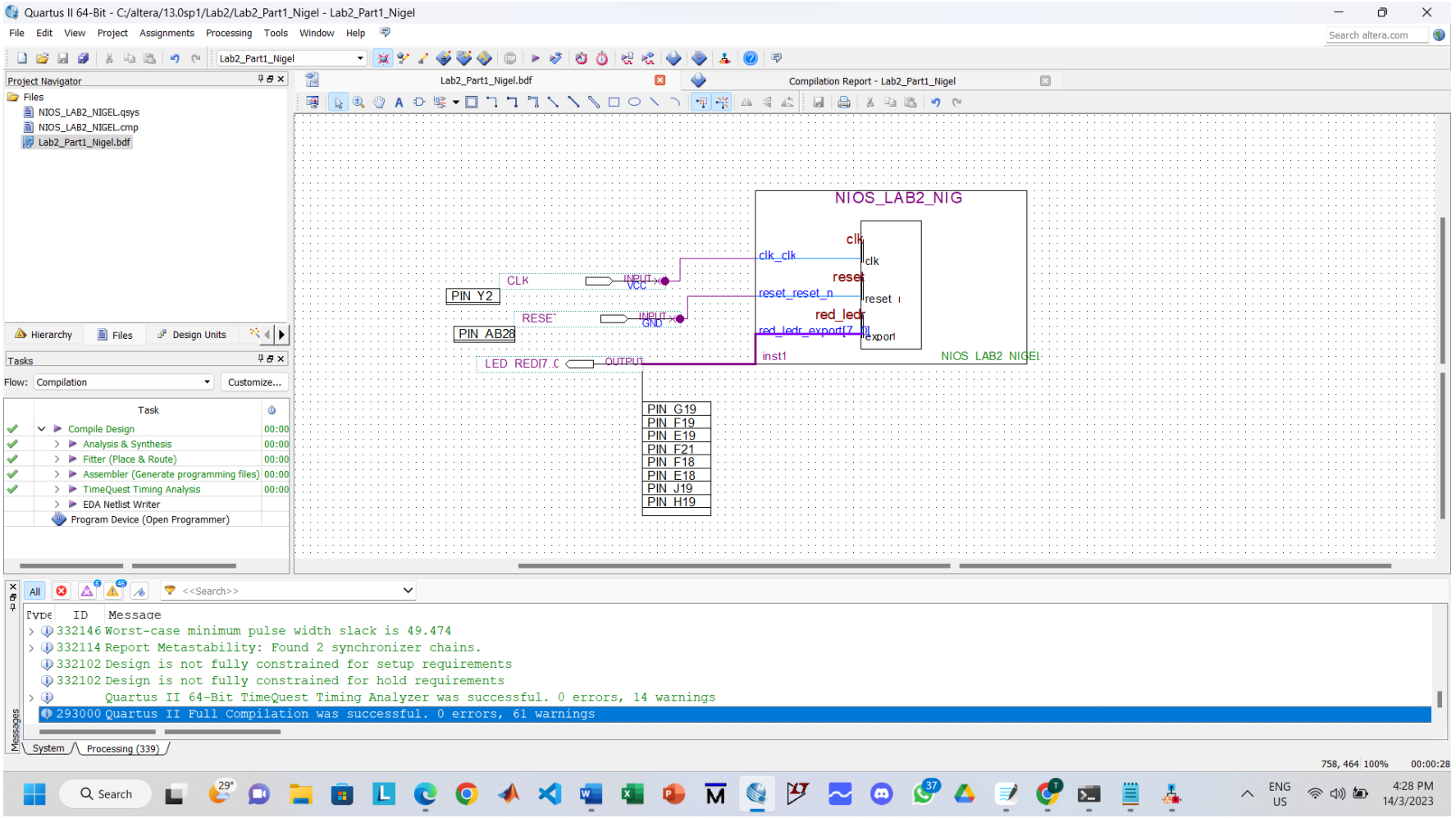

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CODE

```
.global _start
_start:

movia r3, 0x2000
loop:   movia r4, 0xFF
        stwio r4, 0(r3)
        br loop
```

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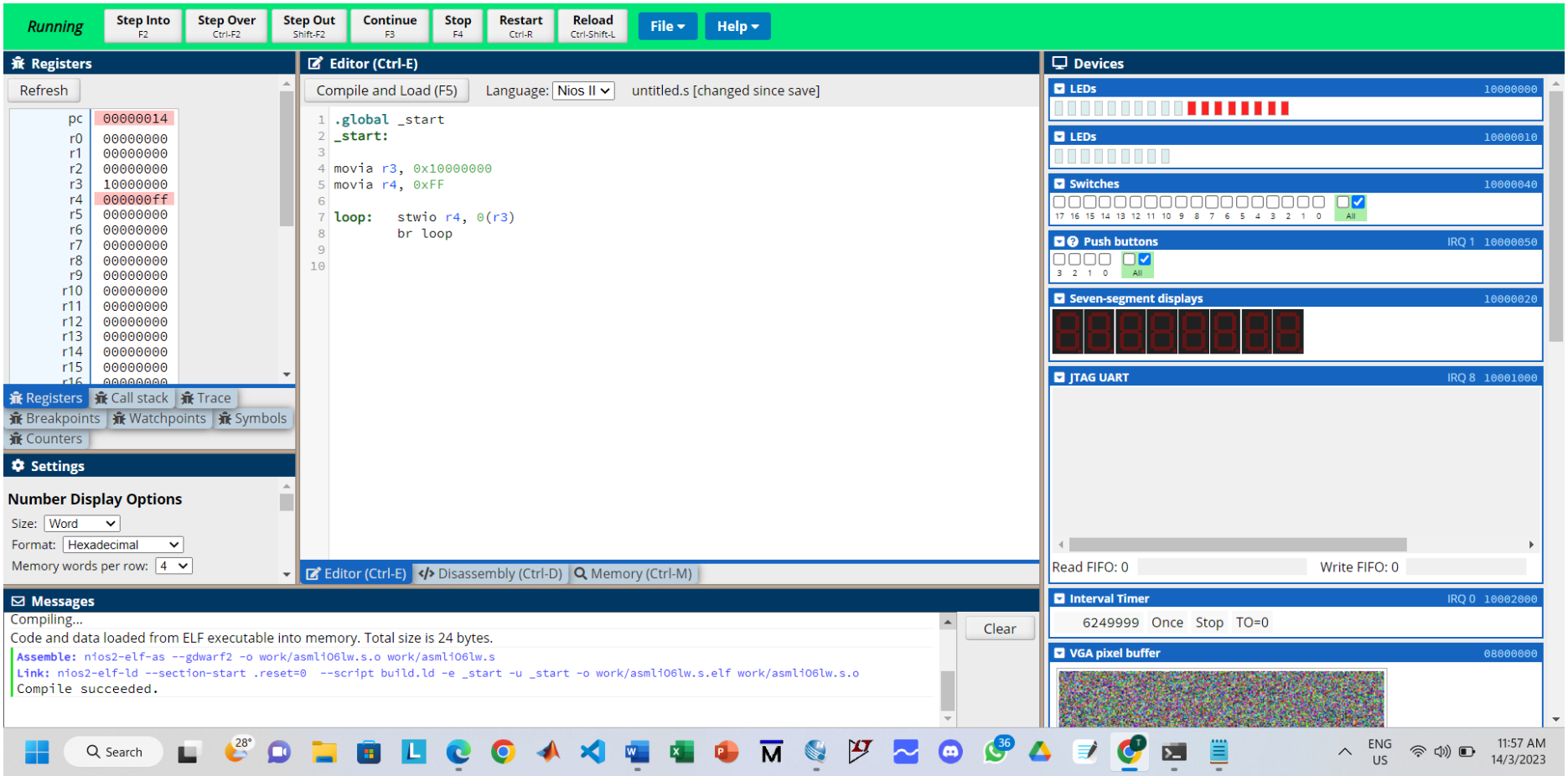
3. Screen shot of CPU simulator : https://cpulator.01xz.net/?sys=nios-de2-115 showing 8 LEDs are HIGH (1 mark)



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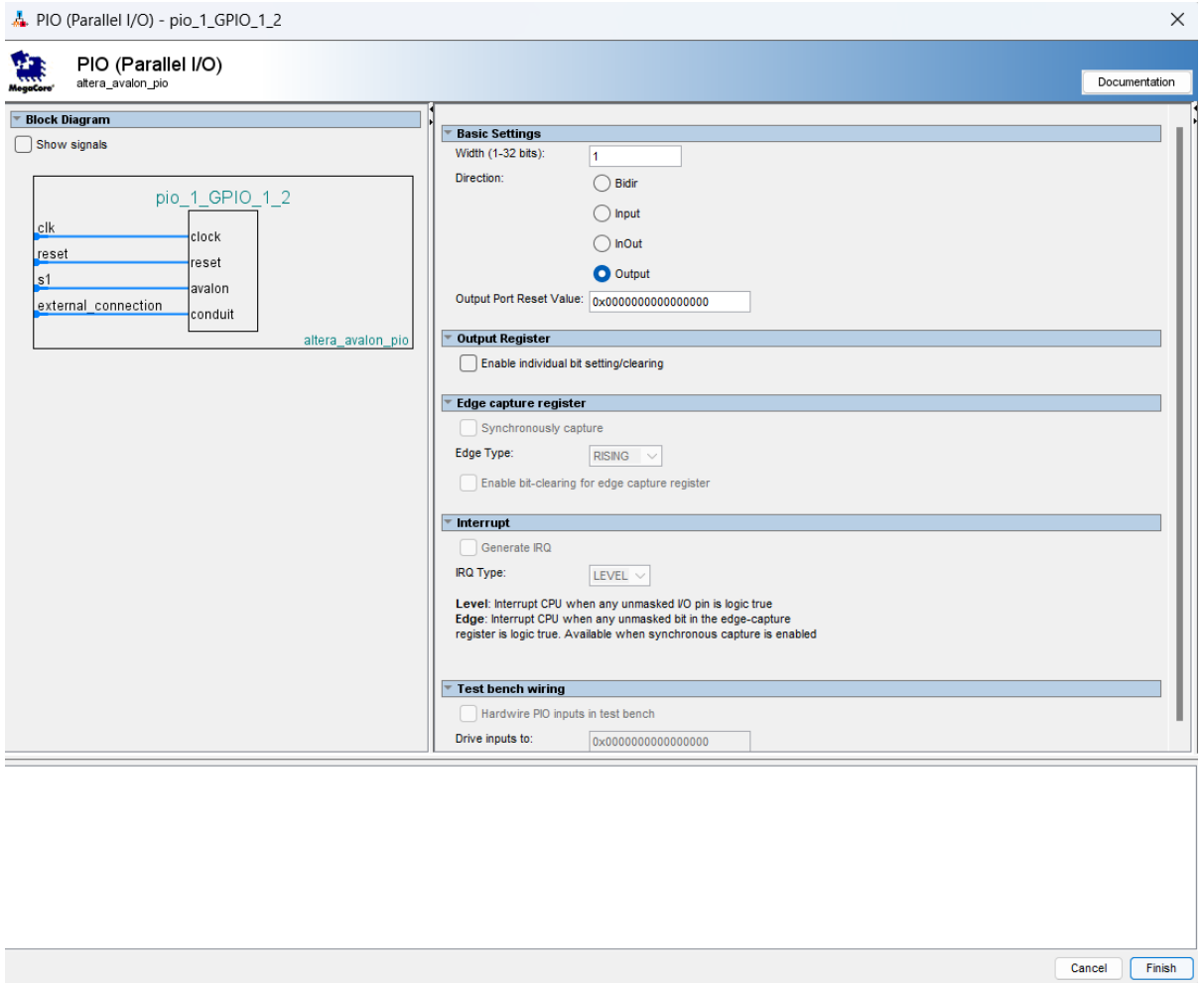
4. Screen shot of QSYS and Schematics that also include a 1-bit GPIO pin (3 marks)



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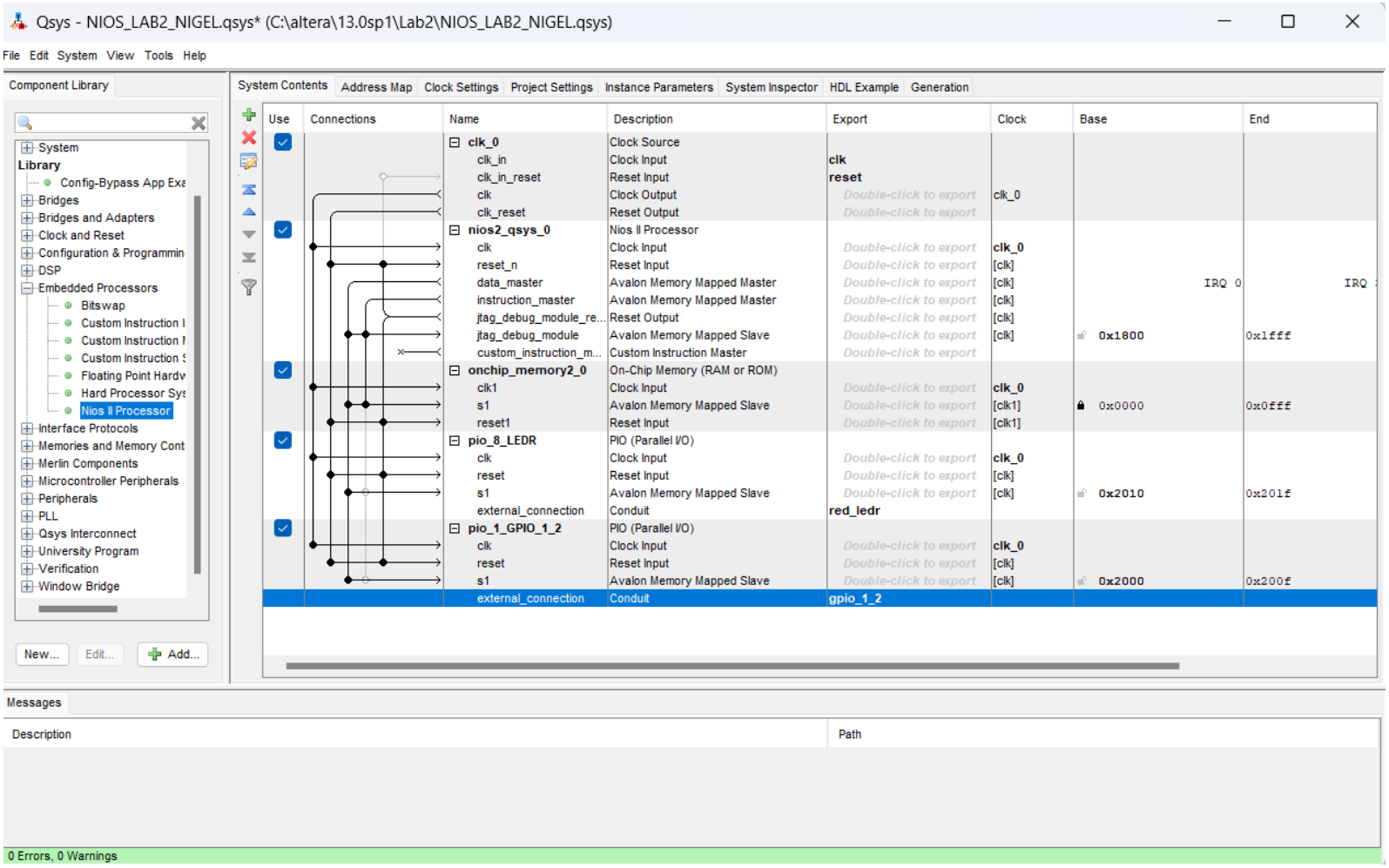

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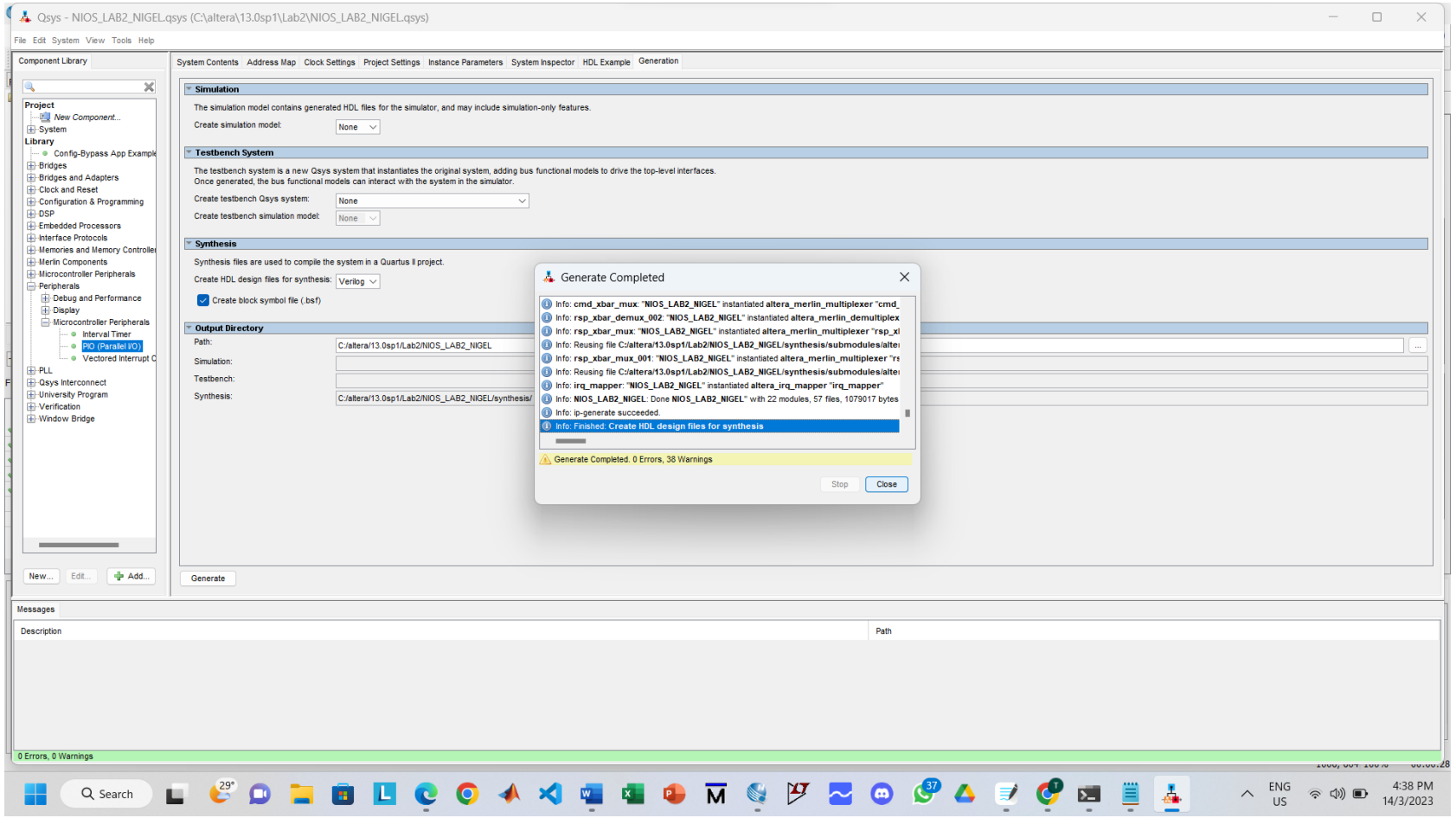

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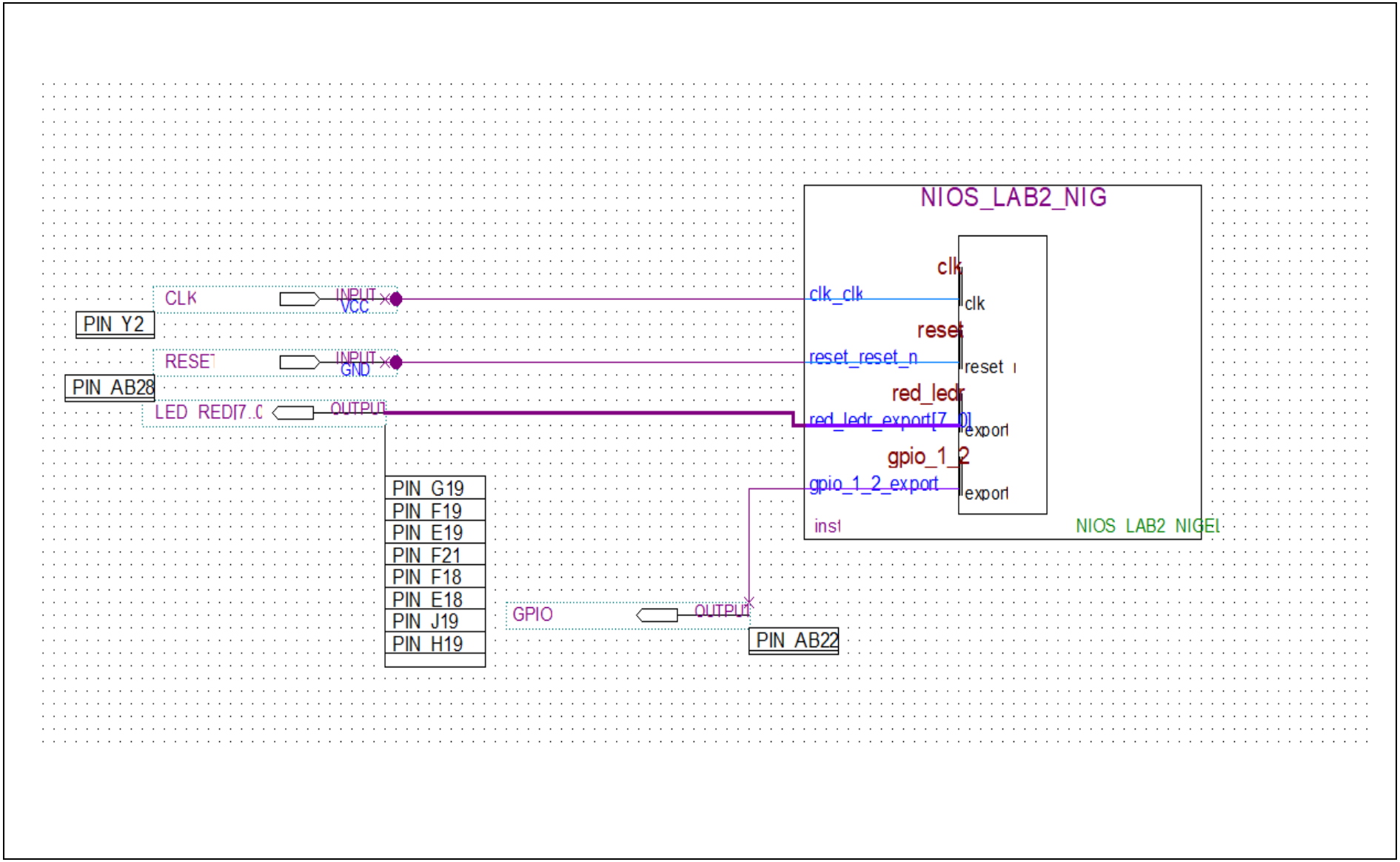

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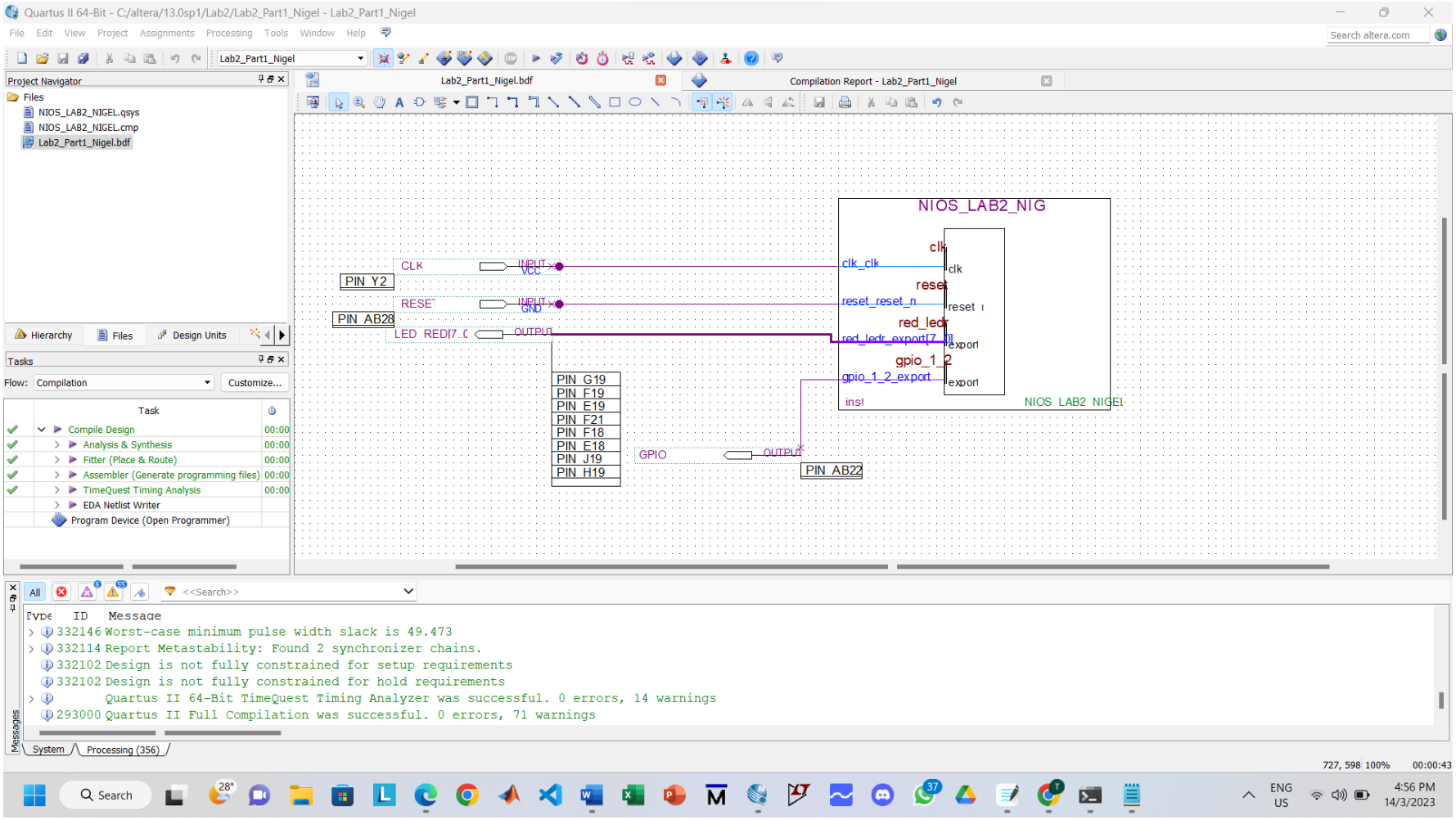

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5. The assembly code that makes GPIO pin ON and immediately next instruction as OFF, such that by connecting GPIO pin to oscilloscope one can measure execution time. (2 marks)

CODE

```
.global _start
_start:

# r5 is set to the GPIO Base Address and r6 is set to be the value of GPIO
movia r5, 0x2000
movia r6, 0x01

# Loop to turn on and off the GPIO
loop:   stwio r6, 0(r5) # Turn on the GPIO
        stwio r0, 0(r5) # Turn off the GPIO
        br loop
```

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6. Complete the assembly codes to solve section f questions in Lab 2 sheet. Execution time of r, j type and I type (3 marks)

CODE

```
global _start
_start:

# initializing the base addresses of the PIO's
# register r3 is the LED base address, r4 is the flag bit base address, r5 stores the address of the LED Pattern
movia r3, 0x2010
movia r4, 0x2000
movia r5, 0x01
movia r6, 0x33
ldw r7, 0(r6)

# Looping
loop:
    stwio r7, 0(r3) # write to red LEDs
    stwio r5, 0(r4) # flag goes high
    stwio r0, 0(r4) # flag goes low
br loop
```

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7. Theoretically estimate the execution time of a R –type, J Type, I- Type (4 marks)

Type of instruction and example	Execution time and number of cycles of cpu
R – Type instruction (Ex: add r8,r9,r10)	1/50MHz = 20ns, 20ns/cycle * 6 cycle = 120ns and 6 cycles of CPU
I Type instruction (andi …)	1/50MHz = 20ns, 20ns/cycle * 6 cycle = 120ns and 6 cycles of CPU
J – Type instruction(jmp or call)	1/50MHz = 20ns, 20ns/cycle * 6 cycle = 120ns and 6 cycles of CPU

To solve this question, you need to refer the instruction set manual, pls refer polling lecture video ☺

8. Practically measure the execution time using Altera University Program and Oscilloscope in the Lab (Not Remote Lab)

Type of instruction and example	Execution time and number of cycles of cpu
R – Type instruction (Ex: add r8,r9,r10)	
I Type instruction (andi …)	
J – Type instruction(jmp or call)	