ELEC1601_ELEC9601 End of Sem (practice)

Started: Nov 7 at 15:40

Quiz Instructions

Question 1 — 1 pts

ID:q1vEA custom digital logic circuit uses two sensors:

- A temperature sensor with integer inputs known to lie in the range [24; 61]
- A humidity sensor with inputs normalised between [0 ; 1] and a precision of 2^-7.

Suppose you wish to represent all possible combinations of these two sensors with a single binary encoding.

What is the minimum number of bits required?

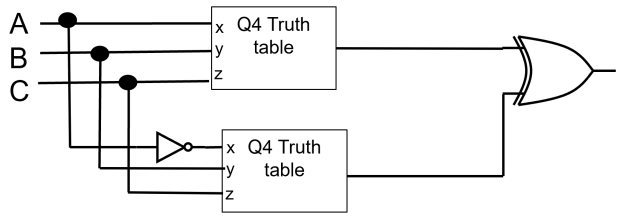
Question 2 — 1 pts

ID:q2vCSuppose you have a circuit that implements the following truth table:

x	y	z	Out
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0

1	1	1	1

Suppose you then create two instances of this circuit and wire them up as follows (the second instance has its first input inverted):

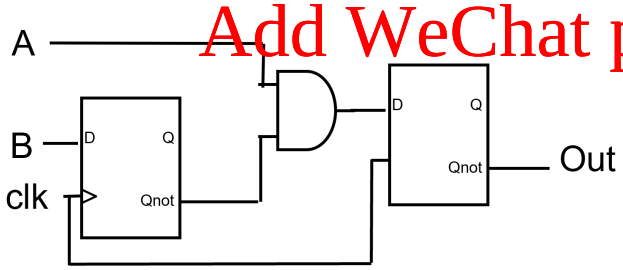


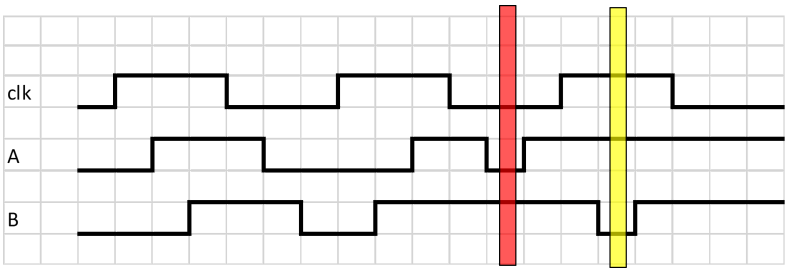
What is the output of the circuit if a=0, b=1, c=0?

Question 3

1 pts

ID:q3vD Study the following circuit and timing diagram (consisting of D-type latches, D-type Flip-Flops and Logic Gates):





What is the value for Out at the highlighted times (if it cannot be determined, write UNKNOWN)

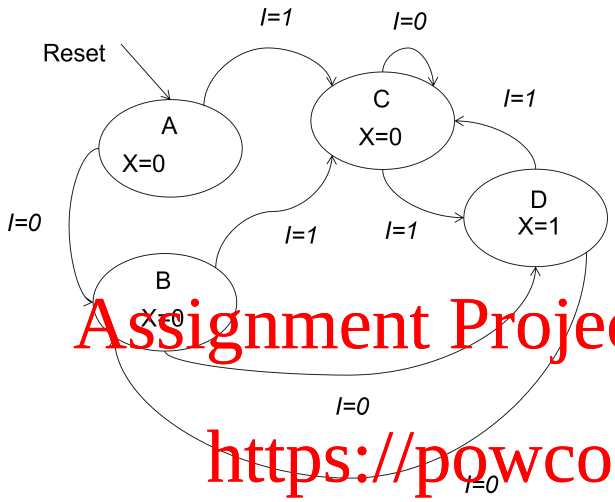
(highlighted red) = [Select]

(highlighted yellow) = [Select]

Question 4

1 pts

ID:q4vA Study the following Finite State Machine:



Complete the truth table showing how to compute the next state from the current state, you should assume the following binary encoding:

State A: 00

State B: 01

State C: 10

State D: 11

Where state(1) (and nextState(1)) is the MSB

State(1)	State(0)	I	nextState(1)	nextState(0)
0	0	0		
0	0	1		
0	1	0		
0	1	1		

1	0	0		
1	0	1		
1	1	0		
1	1	1		

Question 5

1 pts

ID:q5vC Assume that a memory is initialised as follows:

Memory Address	Cell Contents
0xC336	0x01
0xC337	0x00
0xC338	0x00
0xC339	0x11
0xC33A	0x01
0xC33B	0x11

Suppose the X register is initialised to 0xC338 and the following commands are issued:

LD R1, X+

LD R2, X+

ADD R1, R2

ST X, R1

What is the value in 0xC339? (Write your answer in decimal)

Question 6

1 pts

ID:q6vGAssume that a memory is initialised as follows:

Memory Address	Cell Contents
0x00C336	0x64
0x00C337	0x28
0x00C338	0x31
0x00C339	0x13
0x00C33A	0x19
0x00C33B	0x65

A computer system has the value 0x00C338 in its stack pointer. The stack grows (when you push data) towards lower memory positions (numerically lower address). Suppose the system executes the sequence of instructions:

- POP R1
- POP R2
- ADD R1 R2
- MOV R2 R1
- ADD R2 R2
- PUSH R1
- PUSH R2
- PUSH R3

What value is in R3. (Write your answer in decimal. If it cannot be computed given the above information, enter the value 0)

Question 7

1 pts

ID:q7A Suppose the following two instructions are executed:

ANDI R20, 5

BREQ Destination

The machine code for the BREQ instruction is as follows:

1111 0000 0010 1001

Assume the following register values:

Program counter = 0x001 (This corresponds to the location of the ANDI instruction, before execution)

R20 = 0x09

What is the new value of the PC? Write your answer in Decimal.

The relevant information for the instruction set is given below:

18. BREQ – Branch If Equal

18.1. Description

Conditional relative branch. Tests the Zero Flag (Z) and branches relatively to PC if Z is set. If the instruction is executed immediately after any of the instructions CP, CPI, SUB, or SUBI, the branch will occur if and only if the unsigned or signed binary number represented in Rd was equal to the unsigned or signed binary number represented in Rr. This instruction branches relatively to PC in either direction (PC - 63 ≤ destination ≤ PC + 64). Parameter k is the offset from PC and is represented in two's complement form. (Equivalent to instruction BRBS 1,k.)

Operation:

(i) If Rd = Rr (Z = 1) then PC ← PC + k + 1, else PC ← PC + 1

	Syntax:	Operands:	Program Counter:
(i)	BREQ k	-64 ≤ k ≤ +63	PC ← PC + k + 1 PC ← PC + 1, if condition is false

16-bit Opcode:

1111	00kk	kkkk	k001

9. ANDI – Logical AND with Immediate

9.1. Description

Performs the logical AND between the contents of register Rd and a constant, and places the result in the destination register Rd.

Operation:

(i) Rd ← Rd • K

	Syntax:	Operands:	Program Counter:
(i)	ANDI Rd,K	16 ≤ d ≤ 31, 0 ≤ K ≤ 255	PC ← PC + 1

16-bit Opcode:

0111	KKKK	dddd	KKKK

9.2. Status Register (SREG) and Boolean Formula

I	T	H	S	V	N	Z	C
–	–	–	⇔	0	⇔	⇔	–

S N ⊕ V, for signed tests.

V 0

Cleared.

N R7

Set if MSB of the result is set; cleared otherwise.

Z $\overline{R7} \bullet \overline{R6} \bullet \overline{R5} \bullet \overline{R4} \bullet \overline{R3} \bullet \overline{R2} \bullet \overline{R1} \bullet \overline{R0}$

Set if the result is 0000; cleared otherwise.

Question 8 1 pts

ID:q8E Study the following code (you can assume ". . ." refers to code that is not shown)

```
main:
        ...
        LDI R27, hi8(d1)    ; PC = 0x0A31, SP = 0x0B13
        LDI R26, lo8(d1)
        LD  R18, X+
        ADD R18, R18
        PUSH R0
        CALL subroutine1
        POP R18       ; What is the value of the PC after the completion of this line
 of code?
        ...

subroutine1:
        POP R18
        ...
        RET
```

You can assume that the address of subroutine1 is 0x1A16 and that this code was generated by the AVR-GCC compiler and follows the relevant conventions

What is the value of the Program Counter after the completion of the highlighted line of code? (Write your answer in Decimal)

Question 9

1 pts

ID:q9DConsider the following definitions for d1, which represents a 4 byte array of integer values:

- d1: .byte 0, 1, 2, 3

(1st element of the array for d1 has the value 0, 2nd element of the array for d1 has the value 1, 4th element of the array has the value 3)

If d1 is located in address 0x0324, what is the value of the second element of d1 after executing the following instructions? (Write your answer in Decimal)

- LDI R27, hi8(d1)
- LDI R26, lo8(d1)
- LDI R19, hi8(d1)
- LDI R18, lo8(d1)
- ST X+, R18
- ADD R19 R18
- ST -X, R19

Question 10

1 pts

ID:q10EAn AVR assembly program defines the following variables and labels:

.section .data

D1: .byte 5, 4, 8

D2: .byte 6, 1, 5

If the address of D1 is 0x55, what is the address of D2? (Write your answer in Decimal)

Question 11 1 pts

ID:q11FWhat is the decimal value (base 10) held in R9 after the following sequence of instructions?

LDI R18, 0x85

MOV R9, R18

ADD R9, R9

Question 12 1 pts

ID:q12EStudy the following program

It was generated by the compiler avr-gcc that uses the AVR libc library, so obeys the convention for register management

```
...
LDI  R18, 7
PUSH R18
PUSH R20
```

```
CALL subroutine1; Call the subroutine
POP R2
POP R3
ADD R20 R2
ADD R20 R3
...
```

```
subroutine1:
        ...
        ADD R18 R20; Values for the registers after completion of this line of code a
re shown in the text below
        PUSH R0;
        RET;
```

Suppose at the start of the subroutine, R20 = 3;

Suppose near the end of the subroutine after completion of the line highlighted in Red: R0=4, R2=5, R18=5

What is the value stored in R20 at the line highlighted in Green? Write 0 if unknown. Write your answer in Decimal

Question 13 1 pts

ID:q13A Study the following program

It was generated by the compiler avr-gcc that uses the AVR libc library, so obeys the convention for register management. The return address is assumed to occupy 2 bytes in the activation stack.

```
...
LDI  R20, 8
LDI  R21, 7
LDI  R22, 8
LDI  R23, 3
LDI  R24, 7
PUSH R20
PUSH R21
PUSH R22
PUSH R23
PUSH R24
CALL subroutine1; Call the subroutine
...
```

```
subroutine1:
        IN R31, 0x3E   ; Z <- SP
        IN R30, 0x3D
        LDD R18, Z+4
        LDD R19, Z+5
        ADD R18, R19  ; What is the value for R18 after execution of this line?
        ...
```

Reminder, the IN R31, 0x3E ; IN R30, 0x3D commands load the stack pointer into the Z register

What is the value stored in R18 in subroutine 1 (before the ...). Write 0 if unknown. Write your answer in Decimal

Question 14 1 pts

Study the following handwritten (potentially buggy) code (you can assume ". . ." refers to code that is not shown


```
main:
        ...
        LDS R25, 
        PUSH R25,
        CALL subroutine1 ; This instruction is at location 0x1231
        POP R0,
        ...
subroutine1:             ; This subroutine is at location 0xAB88
        MOV R25, R8
        CALL subroutine2
        ...
        MOV R24, R7   ; result
        RET
subroutine2:            ; This subroutine is at location 0xAD84. No code is missing f
rom this subroutine
        ADD R8 R8
        PUSH R8
        ADD R8 R8
        PUSH R8
        ADD R8 R8
        PUSH R8
        RET
```


Assume the return address stored in the stack by the CALL instruction is 3 bytes.

What is the value of the Program Counter after the RET instruction in Subroutine 2? (Write your answer in Decimal, write 0 if unknown)

Question 15

1 pts

Suppose you have a computer system with a 4 stage pipeline and clock period of 193 ns.

Assuming there are no pipeline stalls (no branching, no I/O requests, no interrupts etc.), how long would it take to execute the following instructions:

ADD R1 R2

ADD R1 R3

SUB R1 R4

Registers R1 to R4 are initialised to 6, 8, 5 and 4 respectively. Your answer should be in ns.

Not saved Submit Quiz