ELEC1601_ELEC9601 End of Sem (practice)

Started: Oct 30 at 21:53

Quiz Instructions

Question 1	1 pts

A machine code must support arithmetic instructions of the following format:

opcode, destination register, source register.

e.g. SUB, R0, R1 translates to perform the subtract R0 - R1 and store the result in R0

The total number of different arithmetic instructions that must be supported is 212, with 2^5 different registers. All bits for this instruction are utilised in the encoding.

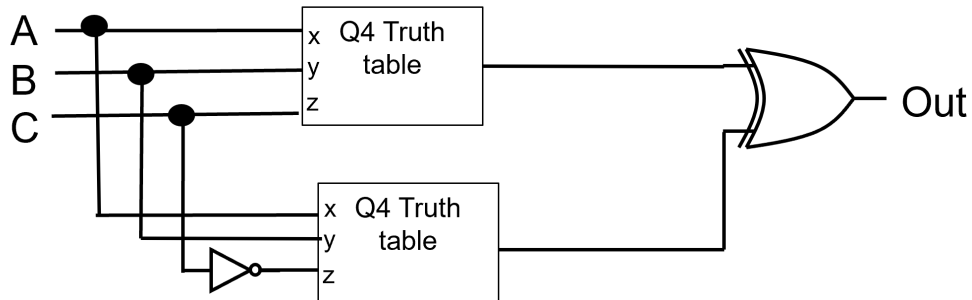What is the minimum number of bits required for this machine code?

Question 2	1 pts

Suppose you have a circuit that implements the following truth table:

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

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 final input inverted):

What is the output of the circuit if a=0, b=1, c=1?
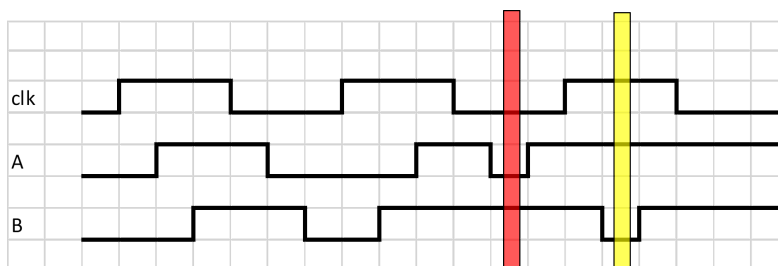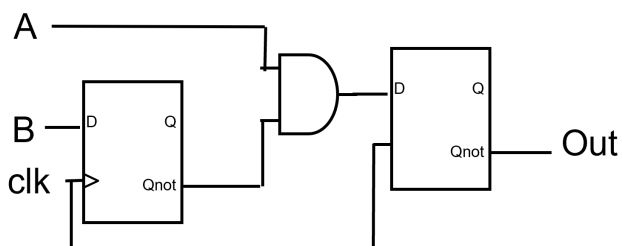
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Question 3   1 pts

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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)
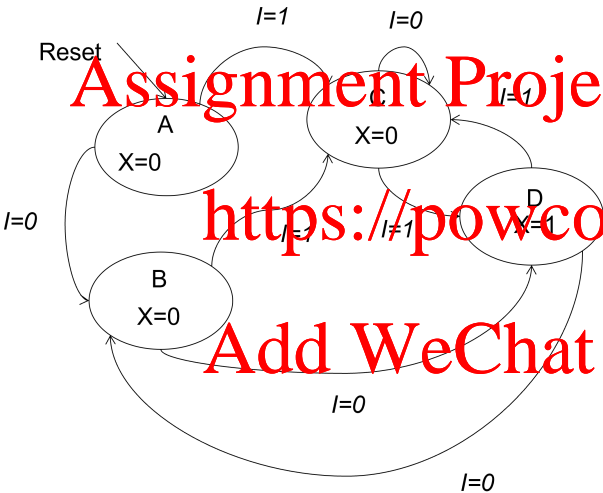
(highlighted red) = [Select]

(highlighted yellow) = [Select]

Question 4

1 pts

Study the following Finite State Machine:

Complete the truth table showing how to compute the next state from the current state:

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**

Assume that a memory is initialised as follows:

Memory Address	Cell Contents
0xC336	0x00
0xC337	0x00
0xC338	0x00
0xC339	0x10
0xC33A	0x00
0xC33B	0x11

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

LD R1, X+

LD R2, X+

What is the value in R2? (Write your answer in decimal)

Question 6   1 pts

Assume that a memory is initialised as follows:

Memory Address	Cell Contents
0x00C336	0x28
0x00C337	0x22
0x00C338	0x35
0x00C339	0x36
0x00C33A	0x85
0x00C33B	0x52

A computer system has the value 0x00C338 in its stack pointer. The stack grows (when you push data) towards lower memory positions. 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

Suppose the following two instructions are executed:

ANDI R20, 5

BREQ Destination

The machine code for the BREQ instruction is as follows:

1111 0000 0000 1001

Assume the following register values:

Program counter = 0x001

R20 = 0x09

What is the new value of the PC?

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	$16 \le d \le 31, 0 \le K \le 255$	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 R7 • R6 • R5 • R4 • R3 • R2 • R1 • R0

Set if the result is zero; cleared otherwise.

Question 8 — 1 pts

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

```
main:
        ...
        LDI R27, hi8(d1)   ; PC = 0x0A32, SP = 0x0B17
        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 0x1A17 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

Consider 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, 3rd element of the array has the value 2)

If d1 is located in address 0x0326, 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

An AVR assembly program defines the following variables and labels:

.section .data

D1:   .byte 1, 4

D2:   .byte 7, 9, 7

If the address of D1 is 0x43, what is the address of D2? (Write your answer in Decimal)

Question 11   1 pts

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

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LDI R18, 0x24   Add WeChat powcoder

MOV R9, R18

SUB R18, R9

Question 12   1 pts

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

```
LDI  R18, 6
```

```
PUSH R20
CALL subroutine1; Call the subroutine
POP R2
ADD R20 R2
ADD R20 R18
...
```

```
subroutine1:
        ...
        ; Values for the registers after this line of code are shown in the text belo
w
        PUSH R0;
        RET;
```

Suppose at the end of the subroutine (the line highlighted in Red) R0=6, R2=7, R18=1

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

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Question 13 1 pts

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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

```
LDI  R20, 6
LDI  R21, 7
LDI  R22, 7
LDI  R23, 7
LDI  R24, [a5]
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

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Question 14   1 pts

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

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```
main:
    ...
    LDS R25, x
    PUSH R25,
    CALL subroutine1 ; This instruction is at location 0x1279
    POP R0,
    ...
subroutine1:       ; This subroutine is at location 0xAB85
    MOV R25, R8
    CALL subroutine2
    ...
    MOV R24, R7   ; result
    RET
subroutine2:            ; This subroutine is at location 0xAD12. No code is missing f
rom this subroutine
    ADD R8 R8
    PUSH R8
    ADD R8 R8
    PUSH R8
    ADD R8 R8
    PUSH R8
    RET
```

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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 5 stage pipeline and clock period of 155 ns.

Assuming there are no pipeline stalls (no branching, no I/O requests, no interrupts etc.), how many instructions could be completed in 4 s

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