UNIVERSITY OF VICTORIA

EXAMINATIONS DECEMBER 2000

CSC 230 F01: COMPUTER ARCHITECTURE AND ASSEMBLY LANGUAGE

NAME..... STUDENT NO. .....

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TO BE ANSWERED ON THE PAPER **DURATION: THREE HOURS**

STUDENTS MUST COUNT THE NUMBER OF PAGES IN THIS EXAMINATION PAPER BEFORE BEGINNING TO WRITE, AND REPORT ANY DISCREPANCY IMMEDIATELY TO THE INVIGILATOR.

THIS QUESTION PAPER HAS **SEVEN** PAGES PLUS THIS COVER PAGE.

- The exam is worth a total of **100** points.
- Point values for each question are shown in square brackets.
- Read the entire paper carefully before starting work. Attempt every question. Do the easiest questions first. Leave 15 minutes at the end to check your work.
- Answer in the spaces provided (you do not necessarily have to use all the space provided and may use other areas on the **fronts** of the pages if necessary). Use the backs of the pages for rough work.
- This is a closed book examination. **No course notes, books or calculators, are permitted.**
- You are permitted to use the 6811 information sheets provided.

QUESTION	MAX. MARK	STUDENT'SMARK
1	10	
2	8	
3	6	
4	15	
5	12	
6	6	
7	5	
8	12	
9	15	
10	11	
TOTAL	**100**	

1. **[10 marks]**

   a) $1101.101_2 =$ _____ $_{10} =$ _____ $_{16}$

   b) $22.15_{10} =$ _____ $_2 =$ _____ $_{16}$

   c) The 8-bit two's complement representation of -31_{10} is _____ $_2$

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2. **[8 marks]** For the IEEE single precision floating point representation of the decimal value -12.125, complete the following:

   - the value of the sign bit (binary) _____
   - the value stored for the exponent (decimal) _____
   - the stored mantissa (do not show the hidden bit) (binary) _____
   - the complete 32 bit representation (hexadecimal) _____

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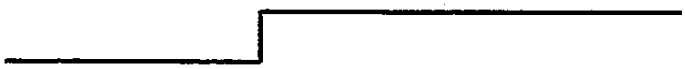
3. **[6 marks]** Perform the following binary division (***perform all steps in binary***):

   $0.100_2 \div 1.1111_2$



4. **[15 marks]** The following program copies string STR2 to string STR1. Parameters are passed to subroutine SCPY via program memory. Fill in the **15** blanks (indicated by _____) in the program shown below so that it behaves as described in the comments.

```
SBASE  EQU    $1FF
       ORG    $100
STR2   FCC    'UVic'
       FCB    _______
STR1   RMB    _______

       ORG    $C000
       LDS    _______
       JSR    SCPY          ; EXECUTE SCPY
       FDB    STR1          ; DESTINATION STRING
       FDB    STR2          ; SOURCE STRING
       STOP

SCPY   _______               ; SAVE USED REGISTERS
       _______
       _______
       TSX
       LDX    _______,X
       LDY    _______,X     ; SET Y TO POINT TO DESTINATION
       LDX    _______,X     ; SET X TO POINT TO SOURCE
SCPY1  LDAA   0,X           ; COPY STRING ONE CHAR AT A TIME
       STAA   0,Y           ; INCLUDING THE TERMINATOR
       BEQ    SCPY2         ; EXIT LOOP AT TERMINATOR
       INX
       INY
       BRA    SCPY1
SCPY2  TSX
       LDY    _______,X
       INY
       INY
       INY
       INY
       STY    _______,X
       _______               ; RESTORE REGISTERS
       _______
       _______
       _______
       END
```

5. **[12 marks]** In the following you are required to write simple instruction sequences that perform the indicated function. The answer to the first question is provided as an example:

   a) program the input capture system to capture the time of a rising edge on IC1

```
LDAB    #$10
STAB    $1021
```

   b) program PORT A to allow bits 0 – 2 to be used as general purpose input port pins.

   c) program the output compare system so that pin 6 of PORT A is toggled each time the contents of TCNT are equal to the contents of the corresponding TOC2.

   d) program PORT D to turn LEDs connected to pins 1 and 3 ON.

6. **[6 marks]** Compare between caches and virtual memory with respect to: purpose, data unit, and method of implementation:

	Caches	**Virtual memory**
purpose		
data unit		
method of implementation		

7. **[5 marks]** Number the following steps from 1 to 5 in the order they are performed in processing an interrupt on the 6811 using the interrupt jump table technique:

___ recognize the interrupt event and set the event flag

___ load the PC with the value from the appropriate interrupt vector

___ execute the first instruction of the interrupt handling routine

___ push the processor registers onto the stack

___ execute the appropriate jump instruction in the jump table

8. **[12 marks]** In a table, differentiate between RISC and CISC with respect to number of registers, memory access, addressing modes, and instruction count, length, and complexity.

Aspect	**CISC**	**RISC**
Number of registers		
Memory access		
Addressing modes		
instruction count		
instruction length		
instruction complexity		

9. **[15 marks]** A push button is connected as an input to IC2. The program below polls IC2 and turns pin 2 of PORT B ON only after the button has been pressed and released the number of times specified by the constant **LIMIT**. For example, in the program below as **LIMIT = 5**, pin 2 of PORT B will not be turned ON until the button has been pressed and releases 5 times.

   Modify the program to use the input capture interrupt capabilities of the 6811. You are required to make the ***minimum*** possible modifications in the given program.

```
REGBASE   EQU    $1000
PORTB     EQU    $4
TMSK1     EQU    $22
TCTL2     EQU    $21
TFLG1     EQU    $23
IC2F      EQU    $8
IC2       EQU    $2
PIN2      EQU    $2
SBASE     EQU    $1FF
LIMIT     EQU    5
COUNT     RMB    1
DONE      RMB    1

MAIN      ORG    $C000
          LDS    #SBASE
          LDY    #REGBASE
          LDAA   #IC2
          STAA   TFLG1,Y
          BSET   TCTL2,Y IC2F
          LDAA   #LIMIT
          STAA   COUNT
          LDAA   #0
          STAA   DONE
AGAIN     JSR    CHECK
          TST    DONE
          BEQ    AGAIN
          LDAA   #PIN2
          STAA   PORTB,Y
          STOP

CHECK     PSHA
LOOP      BRCLR  TFLG1,Y IC2 LOOP
          LDAA   #IC2
          STAA   TFLG1,Y
          DEC    COUNT
          TST    COUNT
          BNE    EXIT
          INC    DONE
EXIT      PULA
          RTS
          END
```

(Answer to question: 9)

10. [11 marks]

a) **[3 marks]** What is the key feature of a load/store machine?

b) **[1 mark]** What is the purpose of the PC register on the 6811?

c) **[3 marks]** State 3 distinct situations in which the value in the PC is modified.

d) **[2 marks]** Explain the functional differences between the 6811 JMP and JSR instructions.

e) **[2 marks]** Explain the functional differences between the 6811 RTS and RTI instructions.

END OF EXAMINATION