Points missed: _____ Student's Name: _____

Total score: _____/100 points

East Tennessee State University -- Department of Computer and Information Sciences
CSCI 2150 – Computer Organization
Final Exam for Spring Semester, 2002
Instructor: David Tarnoff

Section 001

Read this before starting!

- The total possible score for this test is 100 points.
- This test is closed book and closed notes
- **All** answers **must** be placed in blanks provided. Failure to do so will result in no credit for answer.
- **1 point** will be deducted per answer for missing or incorrect units when required. **No** assumptions will be made for hexadecimal versus decimal, so you should always include the base in your answer.
- If you perform work on the back of a page in this test, indicate that you have done so in case the need arises for partial credit to be determined.
- ***Calculators are not allowed.*** Use the tables below for any conversions you may need. Leaving numeric equations is fine too.
- You may use one sheet of scrap paper that you will turn in with your test.

Binary	Hex
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7

Binary	Hex
1000	8
1001	9
1010	A
1011	B
1100	C
1101	D
1110	E
1111	F

Power of 2	Equals
2^3	8
2^4	16
2^5	32
2^6	64
2^7	128
2^8	256
2^9	512
2^{10}	1K

"Fine print"

The following is from section 5.7 "Academic Misconduct" of the ETSU Faculty Handbook, June 1, 2001:

"Academic misconduct will be subject to disciplinary action. Any act of dishonesty in academic work constitutes academic misconduct. This includes plagiarism, the changing or falsifying of any academic documents or materials, cheating, and the giving or receiving of unauthorized aid in tests, examinations, or other assigned school work. Penalties for academic misconduct will vary with the seriousness of the offense and may include, but are not limited to: a grade of 'F' on the work in question, a grade of 'F' of the course, reprimand, probation, suspension, and expulsion. For a second academic offense the penalty is permanent expulsion."

DEC - Decrement
Usage: DEC dest
Modifies flags: AF OF PF SF ZF
Description: Unsigned binary subtraction of one from the destination.

INC - Increment
Usage: INC dest
Modifies flags: AF OF PF SF ZF
Description: Adds one to destination unsigned binary operand.

Jxx - Jump Instructions Table

Mnemonic	Meaning	Jump Condition
JE	Jump if Equal	ZF=1
JG	Jump if Greater (signed)	ZF=0 and SF=OF
JGE	Jump if Greater or Equal (signed)	SF=OF
JL	Jump if Less (signed)	SF != OF
JLE	Jump if Less or Equal (signed)	ZF=1 or SF != OF
JMP	Unconditional Jump	unconditional
JNA	Jump if Not Above	CF=1 or ZF=1
JNB	Jump if Not Below	CF=0
JNE	Jump if Not Equal	ZF=0
JNG	Jump if Not Greater (signed)	ZF=1 or SF != OF
JNL	Jump if Not Less (signed)	SF=OF
JZ	Jump if Zero	ZF=1

MOV - Move Byte or Word
Usage: MOV dest,src
Modifies flags: None
Description: Copies byte or word from the "src" operand to the "dest" operand.

NOT - One's Compliment Negation (Logical NOT)
Usage: NOT dest
Modifies flags: None
Description: Inverts the bits of the "dest" operand forming the 1s complement.

POP - Pop Word off Stack
Usage: POP dest
Modifies flags: None
Description: Transfers word at the current stack top (SS:SP) to the destination then increments SP by two to point to the new stack top. CS is not a valid destination.

PUSH - Push Word onto Stack
Usage: PUSH src
Modifies flags: None
Description: Decrements SP by the size of the operand (two or four, byte values are sign extended) and transfers one word from source to the stack top (SS:SP).

SAL/SHL - Shift Arithmetic Left / Shift Logical Left
Usage: SAL dest,count SHL dest,count
Modifies flags: CF OF PF SF ZF (AF undefined)
Description: Shifts the destination left by "count" bits with zeroes shifted in on right. The Carry Flag contains the last bit shifted out.

SAR - Shift Arithmetic Right
Usage: SAR dest,count
Modifies flags: CF OF PF SF ZF (AF undefined)
Description: Shifts the destination right by "count" bits with the current sign bit replicated in the leftmost bit. The Carry Flag contains the last bit shifted out.

1.) Fill in the table below for each register named. Points will be lost if your purpose/description is not specific enough. Include name of other register(s) that each register is commonly paired with. (8 points)

Register	# of bits	Purpose/description
IP		
DH		
CS		
DI		

2.) For each of the assembly language commands below, identify the instruction modes of first and second operands (first being the one to the left of the comma) as C-constant, R-register, or A-address. (6 points)

	1st operand	2nd operand
`mov ax,ds`		
`mov [ax+2],54h`		
`jmp 4567h`		
`sal bh,3`		
`mov [bx+2],[1234h]`		

3.) For each of the assembly language commands below, what is the boolean value for the active low signals ^MRDC, ^MWTC, ^IORC, and ^IOWC. (4 points)

	^MRDC	^MWTC	^IORC	^IOWC
`in ah,5674h`				
`mov [1234h],54h`				
`mov ax,[bx]`				
`out 4af5h,bh`				

4.) Assume that ***before*** each of the following instructions, AX=C37Fh. What will ZF, SF, and CF equal ***after*** executing each instruction? ***IMPORTANT: Note that these instructions are not executed in a sequence. Each instruction assumes AX=C37Fh. Leave the flag blank if it is not affected by the instruction.***

Instruction	Zero Flag	Sign Flag	Carry Flag	
`inc al`				(2 points)
`not ax`				(2 points)
`sar ax,3`				(2 points)
`sal al,1`				(2 points)

5.) If I wanted to toggle bit positions 7, 6, 1, and 0 of an 8-bit value, what bit-wise operation and corresponding bit mask would I use?

Operation: _____(1 point) Mask: _____(2 points)

6.) What would the result be if the binary value 01101010b was ANDed bit-wise with the binary value 11110000b? (3 points)

7.) What would be the absolutely quickest way to multiply a register by 8 without using the MULT command? (3 points)

8.) Of the following jump instructions, indicate which ones will jump to the address LOOP, which ones will simply execute the next address (i.e., not jump), and which ones you don't have enough information to tell.

Instruction		Current Flags	Jump to LOOP	Not jump to LOOP	Cannot be determined	
JNL	LOOP	SF=0, ZF=1, OF=0	❑	❑	❑	(2 points)
JNA	LOOP	SF=1, ZF=0	❑	❑	❑	(2 points)
JG	LOOP	SF=0, ZF=0, OF=0	❑	❑	❑	(2 points)
JLE	LOOP	ZF=0, SF=0, OF=1	❑	❑	❑	(2 points)

9.) Assume the register BX contains the value 2000h and the table to the right represents the contents of a short portion of memory. Indicate what value AL contains after each of the following MOV instructions. (2 points each)

Address	Value
DS:2000	23h
DS:2001	5Fh
DS:2002	10h
DS:2003	ACh
DS:2004	5Bh
DS:2005	BCh

MOV AL, DS:[BX] AL =

MOV AL, BH AL =

MOV AL, DS:[BX+5] AL =

MOV AL, DS:[2003] AL =

10.) What physical address does the segment register pair 2400:1234 represent (values are in hex)? (4 points)

11.) Circle the best answer – Machine code is: (2 points)

a) Synonymous with assembly language (i.e., another word for assembly language)
b) Synonymous with high-level languages such as C++ or Visual Basic
c) The words that you use to curse at your PC
d) A language not available to the user that controls the inner workings of the Control Unit
e) Binary values interpreted by the Instruction Decoder to determine what CPU will do next
f) Unique commands used to control specific pieces of the computer's hardware.

12.) Name the two benefits of the segment/pointer addressing system of the 8088 and 8086. (4 points)

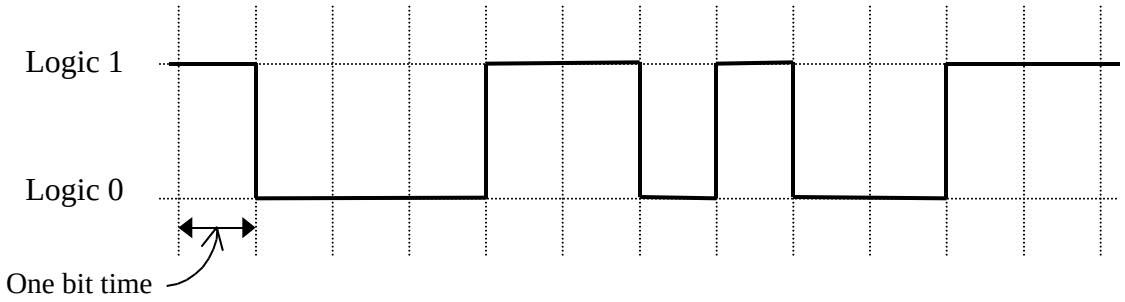
13.) Assume a processor takes 3 cycles to execute any instruction (fetch, decode, execute)

a. How many cycles would a ***pipelined*** processor take to execute 10 instructions? (2 points)

b. How many cycles would a ***non-pipelined*** processor take to execute 10 instructions? (2 points)

14.) On an 80x86 processor with 32 address lines, what is the maximum number of I/O ports? (2 points)

Questions 15, 16, and 17 are based on the following RS232 signal sent with 8 data bits and parity.



15.) What is the binary value being transmitted in this signal? (4 points)

16.) Is the parity bit ODD or EVEN? (2 points)

17.) If the BAUD rate of this signal was 9600 bits/second, what would the data bits per second be? (3 points)

18.) Classify each of the following characteristics as RS232 serial (R), USB (U), Firewire (F), GPIB (G), or SCSI (S). (2 points each)

_____ Developed by Apple for the transmission of video and audio
_____ Can only provide communications between two devices
_____ Primarily used for scientific instrumentation
_____ Has numerous different specifications for wiring and connectors
_____ It is the faster of the two methods that use four conductors (wires) in their cables
_____ Uses two possible data connection speeds on a single network
_____ Parallel data transfer up to 160 MByte/s

19.) What is the accuracy or resolution of a 10-bit analog to digital conversion system with a minimum value of 3 volts and a maximum of 12 volts? ***Just write the equation with the correct values.*** (3 points)

20.) If the voltage range of an 8-bit ADC is from 0 volts to 5 volts, what does a binary output from the ADC of 01100100b = 100 represent? ***Just write the equation with the correct values.*** (4 points)

21.) If an analog to digital conversion system is taking samples once every $1x10^{-6}$ seconds, what is the highest frequency that the sampled data will detect or capture? (3 points)