Points missed: _____ Student's Name: ___________________________________

Total score: _____/100 points

East Tennessee State University
Department of Computer and Information Sciences
CSCI 2150 (Tarnoff) – Computer Organization
TEST 3 for Fall Semester, 2004

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 space provided. Failure to do so may result in loss of points.
- **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.
- The table of assembly language commands is on the last page of this test. Remove it if you wish to have better access to it. Use the backside of it as your scrap paper. Turn it 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
2^{20}	1M
2^{30}	1G

“Fine print”

Academic Misconduct:

Section 5.7 "Academic Misconduct" of the East Tennessee State University 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 of 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."

1. How many latches does a 256 Meg SRAM with 8 data bits per location require? Leave your answer in the form of an equation with numeric values. (2 points)

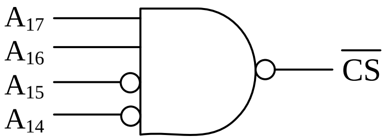
2. Circle ***all*** that apply. A storage cell in a DRAM: (4 points)

   a.) is volatile b.) is a capacitor c.) is cheaper than a cell in an SRAM
   d.) is a latch e.) must be refreshed regularly f.) is smaller than a cell in an SRAM
   g.) is typically used for cache RAM h.) is faster than a cell in an SRAM

3. Match each of the settings of the bus control signals $\overline{R}$ and $\overline{W}$ on the left with the bus operation on the right. (4 points)

$\overline{R}$	$\overline{W}$			Operation of the bus
0	0	□	□	Processor reads from memory
0	1	□	□	Illegal setting
1	0	□	□	The bus is idle
1	1	□	□	Processor writes to memory

4. What are the high and low addresses ***(in hexadecimal)*** of the memory range defined with the chip select shown to the right? (6 points)



   Low address: ___________________ High address: _______________________

5. For the chip select in the previous problem, how big is the memory chip that uses this chip select? (3 points)

6. Using logic gates, design an active low chip select for a RAM placed in a 1 Meg memory space with a low address of 60000_{16} and a high address of $6FFFF_{16}$. ***Label all address lines used for chip select.*** (7 points)

7. What is the largest memory that can have a starting (lowest) address of $AC8000_{16}$? (3 points)

8. True or false: The address range $C000_{16}$ to $DFFF_{16}$ is a valid range for a single memory. (2 points)

9. True or false: There are more sectors per track in the outer tracks of a ***multiple zone recording*** hard drive configuration than there are in the inner tracks. (2 points)

10. True or false: The Winchester-type head of a hard drive does not move from the landing zone until the hard drive platters are up to speed. (2 points)

11. True or false: A small gap is left between the tracks of a hard drive disk in order to avoid data bleeding over into (interfering with) the data from other tracks. (2 points)

The table below represents a small section of a cache that uses direct mapping. Refer to it to answer questions 12, 13, and 14.

Line number (decimal & binary)	Tag (binary only)	Word within the block								
		000	001	010	011	100	101	110	111	
$99_{10} = 01100011_2$	011011010	00_{16}	61_{16}	$C2_{16}$	23_{16}	84_{16}	$E5_{16}$	46_{16}	$A7_{16}$	row a
$100_{10} = 01100100_2$	110011010	10_{16}	71_{16}	$D2_{16}$	33_{16}	94_{16}	$F5_{16}$	**56_{16}**	$B7_{16}$	row b
$101_{10} = 01100101_2$	100110101	20_{16}	81_{16}	$E2_{16}$	43_{16}	$A4_{16}$	05_{16}	66_{16}	$C7_{16}$	row c
$102_{10} = 01100110_2$	101100111	30_{16}	91_{16}	$F2_{16}$	53_{16}	$B4_{16}$	15_{16}	76_{16}	$D7_{16}$	row d
$103_{10} = 01100111_2$	000011101	40_{16}	$A1_{16}$	02_{16}	63_{16}	$C4_{16}$	25_{16}	86_{16}	$E7_{16}$	row e
		col 0	col 1	col 2	col 3	col 4	col 5	col 6	col 7	

12. Assuming no leading zeros have been removed from any of the values shown in the table above, how many total lines does this cache have? (2 points)

13. From what address in main memory did the value 56_{16} (the value in bold) come from? Leave your answer in binary. (3 points)

14. A block containing the address $6533B_{16}$ is not contained in this cache. When loaded, which row (a through f) and column (0 through 7) will its value be stored in? (4 points)

15. True or false: A split cache system uses two caches, one for data and one for code. (2 points)

16. What is the purpose of pipelining? (3 points)

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

    a. How many cycles would a ***non-pipelined*** processor take to execute 6 instructions? (2 points)

    b. How many cycles would a ***pipelined*** processor take to execute 6 instructions? (2 points)

Answer questions 18 through 23 using the following settings of the 8086 registers.

```
AX = 0180h        IP = 2122h        CS = 6000h
BX = AA55h        SP = 4344h        SS = 7000h
CX = 03C0h        DI = 6566h        DS = 8000h
DX = FFEEh        BP = 1234h        ES = 9000h
```

18. What is the value contained in the register BL? (2 points)

19. What is the physical address pointed to by ES:BP? (3 points)

20. True or false: The physical address of the next instruction to be executed by the processor can be calculated from the above data? (2 points)

21. What is the value of SP after the execution of the instruction **`PUSH AX`**? (2 points)

22. Assume that the instruction **`INC DH`** is executed. How would the following flags be set? ***Write "N/A" if the flag was not affected.*** (3 points)

    ZF = ______ CF = ______ SF = ______

23. Assume that the instruction **`SAR BH,3`** is executed. What would the new value of BH be? (3 points)

24. Assume AX=1000h, BX=2000h, and CX=3000h. After the following code is executed, what would AX, BX, and CX contain? (3 points)

```
PUSH CX
PUSH BX
PUSH AX
POP CX
POP BX
POP AX
```

Place your answers in space below:

AX =

BX =

CX =

25. Which of the following best describes the operation of the instruction MOV AX, [1000h]? (2 pts)

a.) Load the 16-bit register AX with the number 1000_{16}.
b.) Store the value currently held in the 16-bit register AX to the address 1000_{16}.
c.) Load AX with the value stored at address 1000_{16}.
d.) Load AX with the value stored at address pointed to by the value stored at the address 1000_{16}.
e.) None of the above, this is an illegal instruction.

26. 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	
JNE	LOOP	SF=0, OF=1, CF=1	□	□	□	(2 points)
JA	LOOP	CF=0, ZF=1, OF=0	□	□	□	(2 points)
JNB	LOOP	SF=0, ZF=0, CF=0	□	□	□	(2 points)
JNG	LOOP	ZF=1, SF=0, OF=0	□	□	□	(2 points)

27. Name the two benefits of the segment/pointer addressing system of the 80x86. (3 points)

28. Using an original value of 10101010_2 and a mask of 00111100_2, calculate the results of a bitwise AND, a bitwise OR, and a bitwise XOR for these values. (2 points each)

Original value	Bitwise operation	Mask	Result
10101010_2	AND	00111100_2	
10101010_2	OR	00111100_2	
10101010_2	XOR	00111100_2	

29. For each of the following binary bit patterns, set the parity bit for odd parity.

Binary value	Parity	
0 0 1 0 1 1 0 1	_________	(1 point)
1 1 1 1 0 1 0 0	_________	(1 point)
1 0 1 0 1 0 1 0	_________	(1 point)

30. Keeping your answer in decimal, calculate the basic checksum for the following sequence of bytes. (3 points)

10_{10} 20_{10} 5_{10} 1_{10} 2_{10}

31. When using the 2's complement checksum, the sum of the datasum and the checksum should result in a binary value of what? (2 points)

Name: ________________________________

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: CF AF OF PF SF ZF

Description: Adds one to destination unsigned binary operand.

Jxx - Jump Instructions Table

Mnemonic	Meaning	Jump Condition
JA	Jump if Above	CF=0 and ZF=0
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
JMP	Unconditional Jump	unconditional
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 for 8 or 16 bit and four for 32 bit, 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)

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)

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.