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, 2006

**Read this before starting!**

- The total possible score for this test is 100 points.
- This test is ***closed book and closed notes.***
- ***Please turn off all cell phones & pagers during the test.***
- **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 - 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 an answer as a numeric expression is acceptable.

| 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 |
| $2^{10}$ | 1 kilo (K) |
| $2^{20}$ | 1 mega (M) |
| $2^{30}$ | 1 giga (G) |
| $2^{40}$ | 1 tera (T) |
| $2^{50}$ | 1 peta (P) |

"Fine print"

Academic Misconduct:

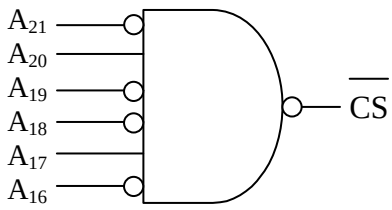
Section 5.7 "Academic Misconduct" of the East Tennessee State University Faculty Handbook, October 21, 2005:

"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. Circle ***all*** that apply. A memory cell in an DRAM: (4 points)

   a.) is cheaper than a cell of an SRAM  b.) is volatile  c.) is refreshed to avoid losing data
   d.) is faster than a cell of an SRAM  e.) is a D latch  f.) is used for main memory
   g.) is smaller than a cell in a SRAM  c.) uses a charge on a capacitor to represent a logic 1

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




   Low address: _____  High address: _____

3. For the chip select in problem 2, how big is the memory chip that uses this chip select? (3 points)

4. For the chip select in problem 2, how big is the memory space of the processor whose address lines are used for the chip select? (3 points)

5. True or false: The address range $68000_{16}$ to $6DFFF_{16}$ is a valid range for a single memory. (2 points)

6. Using logic gates, design an active low chip select for a memory device placed in a 256 Meg memory space with a low address of $7400000_{16}$ and a high address of $77FFFFF_{16}$. ***Label all address lines used for chip select.*** (5 points)

7. A 4 Meg memory can have a starting address of $5D00000_{16}$. (2 points)

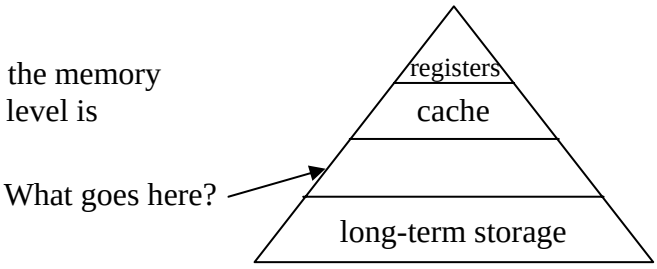
   a.) True  b.) False  c.) Not enough information given

8. A chip select can be designed for a memory device with a starting address of $2C000_{16}$ for a processor with a 256 Meg memory space. (2 points)

   a.) True  b.) False  c.) Not enough information given

9. Name the primary characteristic of storage devices that ***improves*** as you move ***closer*** to the processor through the memory hierarchy? (2 points)

10. To the right you should see a figure representing the memory hierarchy with one of the levels missing. Which level is missing? (2 points)




11. List one of the two reasons discussed in class why data encoding is necessary to store data on a hard drive, i.e., why must a pattern of polarity changes be used to store data instead of simply having one polarity direction represent 1's while the other direction represents 0's. (2 points)

12. FM encoding has a magnetic polarity change at the beginning of every bit time and in the middle of a bit time representing a logic 1. Therefore, the width of 1 bit is equal to _____ times the width of the gap in the hard drive's write head, i.e., the minimum length of a polarity change. (2 points)

    a.) ½  b.) ¾  c.) 1  d.) 1.5  e.) 2  f.) 3  e.) varies

13. Circle ***one***: A gap is left between tracks on a hard drive. This is to: (2 points)

    a.) provide flexibility in case a new encoding algorithm is used
    b.) provide synchronization, i.e., help the hard drive controller know where the head is positioned
    c.) prevent data from "bleeding over" from one track to the next.
    d.) none of the above

14. Circle ***one***: Which of the following statements best describes Multiple Zone Recording? (2 points)

    a.) The rate at which data is read from the disks remains constant regardless of head position.
    b.) The hard drive controller may change the rotational speed of the platters/disks.
    c.) Special encoding is used on the platters/disks to identify the position of the disks.
    d.) Outer tracks have a greater number of sectors to take advantage of the capabilities of the head.
    e.) More than one head is used per side of a platter/disk.

15. True or false: The drawback of ***multiple zone recording*** hard drives is that the controller is more complex than that of constant angular velocity hard drives. (2 points)

16. Describe how the LRU replacement algorithm for the fully associative mapping algorithm works. (2 points)

17. True or false: In a properly operating fully associative cache, it is possible to have two lines with identical tags. (2 points)

*The table to the right represents a small section of a cache that uses fully associative mapping. Refer to it to answer questions 18 through 22.*

18. Assuming the tags shown to the right do ***not*** delete leading zeros, how many address lines does the processor that uses this cache have? (2 points)

19. What is the block size (in number of memory locations) for the cache shown to the right? (2 points)

| | Word ID | | | |
|---|---|---|---|---|
| Tags (in binary) | 00 | 01 | 10 | 11 |
| 0110110110010110000110 | $A0_{16}$ | $01_{16}$ | $62_{16}$ | $00_{16}$ |
| 1001101101001101101000 | $6B_{16}$ | $71_{16}$ | $D7_{16}$ | $11_{16}$ |
| 0000111101101001101001 | $C0_{16}$ | $21_{16}$ | $82_{16}$ | $22_{16}$ |
| 1011001001100110111110 | $3D_{16}$ | $93_{16}$ | **$F9_{16}$** | $33_{16}$ |
| 1001001101101010110101 | $E0_{16}$ | $31_{16}$ | $02_{16}$ | $44_{16}$ |
| 0100101011010011010101 | $5F_{16}$ | $B5_{16}$ | $2A_{16}$ | $55_{16}$ |
| 0011111110001100110011 | $BB_{16}$ | $CC_{16}$ | $89_{16}$ | $9A_{16}$ |
| 1010011100010011010001 | $AA_{16}$ | $DD_{16}$ | $67_{16}$ | $AB_{16}$ |
| 1111111110000000110011 | $99_{16}$ | $EE_{16}$ | $56_{16}$ | $BC_{16}$ |
| 0101101100000000011101 | $88_{16}$ | $FF_{16}$ | $45_{16}$ | $CD_{16}$ |
| 0101100101001111111111 | $77_{16}$ | $01_{16}$ | $34_{16}$ | $EF_{16}$ |
| | col A | col B | col C | col D |

20. From what address in main memory did the value $F9_{16}$ (the value in bold) come from? Leave your answer in binary. (3 points)

21. A copy of the data from memory address $A71345_{16}$ is contained in the portion of the cache shown above. What is the value stored at that address? (3 points)

22. ***If*** the block containing memory address $13C249_{16}$ were to be loaded into the cache described above, which column, A, B, C, or D would the value be loaded into? (Note: This value it is not represented in the data shown above.) (2 points)

23. True or false: The primary reason discussed in class for forcing a processor's pipeline to be flushed is when a branch occurs. This can be caused by things like an if-statement or a loop. (2 points)

24. 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 7 instructions? (2 points)

    b. How many cycles would a ***pipelined*** processor take to execute 7 instructions? (2 points)

25. What are the settings of the zero flag, the sign flag, the carry flag, the overflow flag, and the parity flag after a processor performs the addition shown to the right? (5 points)

```
  1  11
    11110001
+ 10010010
  10000011
```

ZF = _____ SF = _____ CF = _____ OF = _____ PF = _____

26. Remember that a compare is basically a "virtual subtract", i.e., CMP A, B is the same thing as setting the flags after the operation A – B. What would the values of ZF and SF be if A is less than B? (2 points)

ZF = _____ SF = _____

27. What is the purpose of the ALU? (2 points)

28. Assume AX=$1000_{16}$, BX=$2000_{16}$, and CX=$3000_{16}$. After the following code is executed, what would AX, BX, and CX contain? (3 points)

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

Place your answers in space below:

AX =

BX =

CX =

29. Name one of the three purposes discussed in class for a stack. (2 points)

30. How does the processor determine what to put in the sign flag (SF)? In other words, what part of the result is used to determine what goes in the sign bit? (2 points)

31. Remember that a signed magnitude binary value uses the first bit as the sign bit. If we flip it, we change it from a positive to a negative number or vice versa. Which bitwise operation could be used to flip the sign of a signed magnitude binary value? (2 points)

    a.) AND  b.) OR  c.) XOR  d.) This function is not possible with a bitwise operation

32. Which bitwise operation could be used to find the absolute value of a signed magnitude binary value, i.e., force the sign bit to a 0? (2 points)

    a.) AND  b.) OR  c.) XOR  d.) This function is not possible with a bitwise operation

33. Using an original value of $10100101_2$ and a mask of $00001111_2$, 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 |
|---|---|---|---|
| $10100101_2$ | AND | $00001111_2$ | |
| $10100101_2$ | OR | $00001111_2$ | |
| $10100101_2$ | XOR | $00001111_2$ | |

34. In a 2's complement checksum scheme, the receiving processor adds all of the words of data, then adds the received checksum to the resulting datasum. Disregarding any carry, the final result should be: (2 points)

    a.) a binary number with all 1's
    b.) a binary number with all 0's
    c.) a binary number equal to the checksum
    d.) none of the above

35. There are two ways of handling the carries that occur when generating the datasum for a checksum. One way is to simply discard all carries. What is the other way? (2 points)

36. A CRC is analogous to what result from what mathematical operation? Be specific. (3 points)

37. For each of the following statements, place a checkmark in the column(s) identifying which protocol(s) the statement describes. Some statements have more than one checkmark. (6 points)

| Ethernet | IP | TCP | |
|---|---|---|---|
| ☐ | ☐ | ☐ | Uses addresses that are hard-wired into the network interface cards |
| ☐ | ☐ | ☐ | Is used to manage the partitioning of a large message into smaller messages |
| ☐ | ☐ | ☐ | Uses a logical address defined by a network administrator for its addressing. |
| ☐ | ☐ | ☐ | Uses a 4-byte CRC for error checking |
| ☐ | ☐ | ☐ | Uses a pseudo-header in addition to its frame header to calculate checksum |
| ☐ | ☐ | ☐ | Includes a “time to live” field so that it can be removed from the network(s) in case it cannot find its destination. |