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 Spring Semester, 2007

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, 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 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:

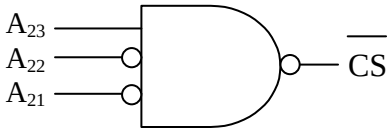
Section 5.7 "Academic Misconduct" of the East Tennessee State University Faculty Handbook, October 21, 2005:

"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. For each of the following statements, place a checkmark in the column identifying which memory technology, SRAM or DRAM, the statement best describes. (1 point each)

SRAM	DRAM	
☐	☐	is typically used as main memory
☐	☐	is typically used as cache RAM
☐	☐	is made from capacitors
☐	☐	needs to be refreshed/rewritten when read
☐	☐	is the faster of the two technologies

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. What is the largest memory that can have a starting address of 590000_{16}? (3 points)

6. Using logic gates, design an active low chip select for a memory device placed in a 16 Meg memory space with a low address of 280000_{16} and a high address of $2BFFFF_{16}$. ***Label all address lines used for chip select.*** (5 points)

7. A chip select can be designed for a 128K memory device with a starting address of 150000_{16}. (2 points)

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

8. A chip select can be designed for a memory device with an ending address of $35FFFF_{16}$ for a processor with a 128K 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 ***away*** from the processor toward the hard drive through the memory hierarchy? (2 points)

10. By using different encoding methods, hard drive designers are able to increase _____ without changing the physical technology of the drive. (2 points)

    a.) reliability b.) data density c.) error detection d.) throughput (speed data is retrieved)
    e.) A and C f.) B and D g.) A, B, C, and D h.) C and D

11. MFM encoding has a magnetic polarity change in the middle of bit times representing logic ones and between consecutive logic zeros. This means that 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

12. Circle ***one***: A gap is left between sectors 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 sector starts
    c.) prevent data from "bleeding over" from one track to the next.
    d.) to aid in

13. Which method of organizing hard drive sectors requires a more complex controller? (2 points)

    a.) Constant Angular Velocity b.) Multiple Zone Recording c.) Neither

14. Which method of organizing hard drive sectors allows us to achieve higher data density? (2 points)

    a.) Constant Angular Velocity b.) Multiple Zone Recording c.) Neither

15. Name one method for increasing the capacity of a hard drive. (2 points)

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

17. There were two parts to the Principle of Locality. The first was that if a piece of data or code was used once, it would most likely be used again. What was the second part? (2 points)

The table below represents a small section of a cache using fully associative mapping. Each tag and word ID is in binary while the data is in hexadecimal. Refer to it to answer questions 17 through 21.

Tags (binary)	Word within the block															
	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
100110100110	00	61	C2	13	84	E5	46	A7	12	34	56	78	9A	BC	DE	F0
111001011001	60	71	D2	33	94	F5	36	B7	23	45	**67**	89	AB	CD	EF	01
011011011111	20	81	E2	83	A4	05	66	C7	88	99	AA	BB	CC	DD	EE	FF
101110100110	30	91	F2	53	B4	15	A6	D7	FE	DC	BA	98	76	54	32	10
101011001100	40	A1	02	63	C4	25	86	E7	ED	CB	A9	87	65	43	21	0F
000110100110	50	B1	22	73	D4	35	96	F7	11	44	55	77	0F	1F	2F	3F
Column →	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p

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 above? (2 points)

20. From what address in main memory did the value 67_{16} (the value in the second row, column k) come from? Leave your answer in binary. (3 points)

21. A copy of the data from memory address $ACC9_{16}$ 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 $BF16_{16}$ were to be loaded into the cache described above, which column, a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, or p, would the value be loaded into? (Note: This value it is not represented in the data shown above.) (2 points)

23. 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 4 instructions? (2 points)

    b. How many cycles would a ***pipelined*** processor take to execute 4 instructions? (2 points)

24. 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)

```
  111
 10111110
+ 00011001
 11010111
```

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

25. 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 equal to B***? (2 points)

ZF = _____ SF = _____

26. The CPU has four main components. Three of them are the registers, the ALU, and the control unit. What is the fourth component? (2 points)

27. 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)

Place your answers in space below:

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

AX =

BX =

CX =

28. True or False: When the processor "pushes" a register to the stack, it clears the register so that it can be used for another purpose. (2 points)

29. Remember that signed binary values use the first bit as a sign bit. Which bitwise operation could be used to isolate the sign bit to tell if the number is negative, i.e., clear all bits except the MSB? (2 points)

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

30. Which bitwise operation could be used to change an even number to an odd number, i.e., force the least significant bit to a 1? (2 points)

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

31. Using an original value of 00111100_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
00111100_2	AND	00001111_2	
00111100_2	OR	00001111_2	
00111100_2	XOR	00001111_2	

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

33. Name two of the benefits discussed in class of serial communications over parallel. (3 points)

34. The preamble of an Ethernet frame is used to: (2 points)

    a.) check for errors b.) specify the header length c.) specify the data length
    d.) identify the message type e.) identify the end of the frame f.) synchronize receivers

35. 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. (7 points)

Ethernet	IP	TCP	
☐	☐	☐	Uses a 2-byte length to identify the amount of data being transferred
☐	☐	☐	Uses a 4-bit value from which the packet header length can be calculated
☐	☐	☐	Uses addresses that are hard-wired into the network interface cards
☐	☐	☐	Uses a 2-byte checksum for error checking in the header
☐	☐	☐	Limits the data field to a maximum of 1500 bytes
☐	☐	☐	Is used to route messages across multiple networks
☐	☐	☐	Includes a “time to live” field so that it can be removed from the network(s) in case it cannot find its destination.