You may use up to 10 pages of single-side notes and the textbook. You may not use a computer, phone, calculator, or any other electronic equipment except to compile and run exam questions and to look up ASCII / Unicode characters.

1. Memory organization / hierarchy.
   1. Registers
   2. L1, L2 cache
   3. RAM
   4. Disk
   5. Memory Interleaving
2. Measurement systems: storage sizes and timing
   1. KB, MB, GB, TB
   2. ns, µs, ms, sec
3. Numeric conversions:
   1. binary conversions - ones complement, twos complement
   2. Hex addition / subtraction
   3. Big vs Little Endian
   4. IEEE floating point
4. Ranges of numbers in signed and unsigned
5. ASCII / Unicode conversion
6. Instruction execution: Fetch, Decode, Execute
7. Design a circuit from a boolean expression
8. From a circuit what is the boolean expression
9. Give a truth table for a boolean expression
10. MARIE programming

if (A > 5)

B = 6;

A = A + 3 – (C + 4)

LOAD A

ADD Three

SUBT C

SUBT Four

STORE A

HALT

A, DEC 10

C, DEC 12

Three, DEC 3

Four, DEC 4

1. Simple C program
2. RISC vs CISC differences
   1. Fixed vs Variable Length Instructions
   2. RISC has large number of registers
   3. RISC is a load/store architecture
   4. RISC has smaller number of instructions
3. Types of I/O: memory-mapped I/O and instruction-based I/O
4. Types of interrupts and how they are handled
5. RPN:

A + B / C - 4 (infix)

A B C / + 4 - (postfix)

Examples:

-9910 to hex 2-complement.

99 / 2 = 49 r 1

49 / 2 = 24 r 1

24 / 2 = 12 r 0

12 / 2 = 6 r 0

6 / 2 = 3 r 0

3 / 2 = 1 r 1

1 / 2 = 0 r 1

0 1 1 0 0 0 1 1 = 6316

1 0 0 1 1 1 0 0 = one’s complement

+1

1 0 0 1 1 1 0 1 = 9D16

0.12510 to binary and hex

0.125 \* 2 = 0.250

0.250 \* 2 = 0.500

0.500 \* 2 = 1.000

0.000

.00102 = 0.216

Hex arithmetic

1

9A4C

+16B2

=====

B0FE

3210

11 \* 163 + 0 \* 162 + 15 \* 161 + 14 \* 160 = 45310

Big Endian

00 00 B0 FE

Little Endian

FE B0 00 00

Character representation

"789 a π"

ASCII = 37 38 39 20 61 20 ??

Unicode = 0037 0038 0039 0020 0061 0020 03C0

Unicode (little) = 3700 3800 3900 2000 6100 2000 C003

IEEE Single Precision floating point

12.75

1100.112

1.10011 \* 23

0 10000010 100110000000000000000002

414c000016

-99.50

01100011.10002

1.10001110002 \* 26

1 10000101 1000111000...002