A. Single Choice Questions (3%, 45%)

1. In a computer, the _____ subsystem performs calculations and logical operations.
   (A) memory   (B) control unit   (C) input/output   (D) ALU
Correct Answer: (D)

2. Which of the following statement is <u>not true</u>?
   (A) Both Turing or von Neumann models has the concept of the program
   (B) In the Turing model, the output data depends only on the input data without the program
   (C) A universal Turing machine can do any computation if the appropriate program is provided
   (D) A program in the von Neumann model is made of a finite number of instructions
Correct Answer: (B)

3. Which of the following bit patterns (represented in hexadecimal notation) represents a negative number in two's complement notation?
   (A) 3F   (B) 55   (C) A6   (D) 7E
Correct Answer: (C)

4. Which of the following systems is least efficient (requires more space) when encoding integer values?
   (A) Two's complement represetation (B) ASCII (C) Excess system   (D) Sign and magnitude represetation
Correct Answer: (B)

5. A bit pattern 01001000 in memory may represent?
   (A) Numerical value 72 (B) Part of an image (C) A character 'H' encoded with extended ASCII code   (D) All of the above
Correct Answer: (D)

6. Which of the following representations in two's complement notation represents the smallest value?
(A) 00000010
(B) 11110000
(C) 00000001
(D) 11111111
Correct Answer: (B)

7. Which of the following data storage systems provides the most efficient random access to individual data items?
(A) Magnetic disk   (B) Main memory   (C) CDs/DVDs   (D) Flash drives
Correct Answer: (B)

8. In which of the following addition problems (using two's complement notation) does an overflow error occur?
(A) $1100 + 1100$ (B) $1100 + 0100$ (C) $0011 + 1010$ (D) $0100 + 0100$
Correct Answer: (D)

9. Which of the following statement is true?
(A) A NOT gate accepts two inputs
(B) The output of XOR gate is 0 unless both inputs are 1
(C) We can use NOT gate to flip specific bits in a bit string
(D) We can simulate the behavior of XOR gate using AND, OR and NOT gate
Correct Answer: (D)

10. Which of the following statement is true?.
(A) A simple shift operation shifts bits, but no bit is lost or added
(B) Arithmetic shift operations assume that the bit pattern is a signed integer in sign and magnitude format
(C) A logical shift operation is applied to a pattern that does not represent a signed number
(D) An arithmetic left shift retains the sign bit, but also copies it into the next right bit, so that the sign is preserved
Correct Answer: (C)

11. A computer has 64 GB of memory. Each word in this computer is sixteen bytes. How many bits are needed to address any single word in memory?

(A) 32 bits   (B) 36 bits   (C) 26 bits   (D) 22 bits

Correct Answer: (A)

12. Which of the following statement about is <u>not true</u>?

(A)   Both pipelining and parallel processing can improve the throughput of computation

(B)   In the isolated I/O method, the instructions used to read/write memory are totally different than the instructions used to read/write I/O devices.

(C)   One disadvantage of RISC architecture is the overhead associated with microprogramming and access to micromemory.

(D)   DMA controller can transfer a large block of data between a high-speed I/O device, such as a disk, and memory directly without passing it through the CPU

Correct Answer: (C)

13. The _____ layer of the TCP/IP protocol suite is responsible for node-to-node delivery of a frame between two adjacent nodes.

(A)   data-link (B)   transport   (C)   application (D)   physical

Correct Answer: (A)

14. Which of the following is <u>not</u> a protocol in the application layer?

(A) TCP (B) FTP (C) HTTPS (D) SSH
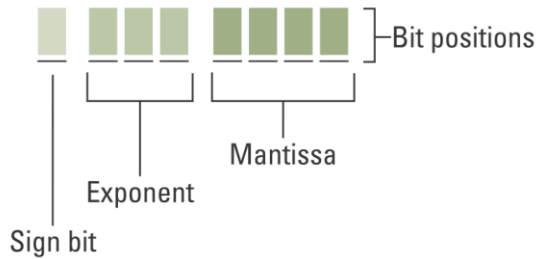
Correct Answer: (A)

15. Which one is the address of a packet used in the transport layer?

(A) MAC address   (B) Port number   (C) Host name (D) IP address

Correct Answer: (B)

B. Short-answer Questions

16. Assume that we have a system that is similar to the IEEE standard but only uses 8 bit to represent the floating-point where the leftmost bit is the sign bit, the following three bit is exponent stored in Excess_3 system and the final five-bit store the mantissa after normalization as follows: (6%)

Try to decode the following bit patterns into a floating point
(a) 01011001
(b) 10101100

Correct answer: a. 6.25 (110.01)   b. -0.875 (-0.111)

17. Convert each of the following base ten representations to its equivalent two's complement representation in which each value is represented in 8 bits. (6%)
a. 93
b. -128

Correct answer: b. 01011101   e. 10000000

18. Convert the following numbers to binary. (6%)
   a. 12.4 (in octal format)
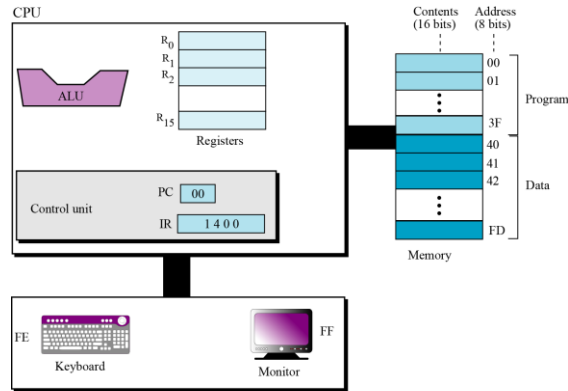   b. 14.625
Correct answer: a. 1010.1   b. 1110.101

19. Write the answer to each of the following problems. (6%)
   a.   10101010 XOR 11110000
   b.   10111110 AND 11110111
   c.   Arithmetic right shift of 11011000
Correct answer: a. 01011010 b. 10110110 c. 11101100

20. Given the following table (8%)

Instruction	Code	Operands				Action
	d_1	d_2	d_3	d_4		
HALT	0					Stops the execution of the program
LOAD	1	R_D		M_S		$R_D \leftarrow M_S$
STORE	2		M_D	R_S		$M_D \leftarrow R_S$
ADDI	3	R_D	R_{S1}	R_{S2}		$R_D \leftarrow R_{S1} + R_{S2}$
ADDF	4	R_D	R_{S1}	R_{S2}		$R_D \leftarrow R_{S1} + R_{S2}$
MOVE	5	R_D	R_S			$R_D \leftarrow R_S$
NOT	6	R_D	R_S			$R_D \leftarrow \bar{R}_S$
AND	7	R_D	R_{S1}	R_{S2}		$R_D \leftarrow R_{S1}$ AND R_{S2}
OR	8	R_D	R_{S1}	R_{S2}		$R_D \leftarrow R_{S1}$ OR R_{S2}
XOR	9	R_D	R_{S1}	R_{S2}		$R_D \leftarrow R_{S1}$ XOR R_{S2}
INC	A	R				$R \leftarrow R + 1$
DEC	B	R				$R \leftarrow R - 1$
ROTATE	C	R	n	0 or 1		$Rot_n R$
JUMP	D	R	n			IF $R_0 \neq R$ then PC = n, otherwise continue

Key: R_S, R_{S1}, R_{S2}: Hexadecimal address of source registers
R_D: Hexadecimal address of destination register
M_S: Hexadecimal address of source memory location
M_D: Hexadecimal address of destination memory location
n: Hexadecimal number
d_1, d_2, d_3, d_4: First, second, third, and fourth hexadecimal digits

write the code for a program that performs the following calculation:

$$C \leftarrow A - B$$

A, B and C are integers in two's complement format. The user types the value of A and B and the value of C is stored into the memory. (The data needs to be stored in the data memory)

Correct answer:
$(1FFE)_{16}$ // $R_F \leftarrow M_{FE}$, Load A from keyboard to R_F
$(240F)_{16}$ // $M_{40} \leftarrow R_F$, Store A in M_{40}
$(1FFE)_{16}$ // $R_F \leftarrow M_{FE}$, Load B from keyboard to R_F
$(241F)_{16}$ // $M_{41} \leftarrow R_F$, Store B in M_{41}
$(1040)_{16}$ // $R_0 \leftarrow M_{40}$, Load A from M_{40} to R_0
$(1141)_{16}$ // $R_1 \leftarrow M_{41}$, Load B from M_{41} to R_1
$(6210)_{16}$ // $R_2 \leftarrow \sim R_1$, Complement B
$(A200)_{16}$ // $R_2 \leftarrow R_2 + 1$

$(3302)_{16}$ // $R_3 \leftarrow R_0 + R_2$, A+~B+1 (A-B)
$(2423)_{16}$ // $M_{42} \leftarrow R_3$, Store the results to M_{42}
$(0000)_{16}$ // Halt

21. What is the primary difference between using raster graphics and vector graphics to represent an image? (4%)

Correct answer: The vector graphic encoding does not store the bit patterns for each pixel. An image is <u>decomposed into a combination of geometrical shapes</u> such as lines, squares, or circles. Each geometrical shape is <u>represented by a mathematical formula</u>

22. An audio signal is sampled 8000 times per second. Each sample is represented by 256 different levels. How many bytes per second are needed to represent this signal? (4%)

Correct answer: 256 level can be represented by 8 bits. Therefore, the number of bits per seconds is (8000 sample/ sec) × (8 bits / sample) = 64,000 bits /seconds=8,000 bytes/seconds.

23. Compare the range of 16-bit port addresses with the range of 128-bit IPv6 addresses. Why do we need such a large range of IP addresses, but only a relatively small range of port numbers? (5%)

Correct answer: The domain of IP addresses is universal. A device directly connected to the Internet <u>needs a unique IP address</u>. The <u>domain of port numbers is local</u>; they can be repeated. Two computers running the HTTP server process use the same well-known port number (80); two computers running the HTTP client process can use the same ephemeral port number.

24. Write the entire URL required to retrieve the Web document named dogs.html from the Webserver at animals.org assuming that the document is stored in the directory named dogs and the server are using the http protocol with custom port 100. (4%)

Correct answer: `http://animals.org:100/dogs/bulldogs.html`

25. Rewrite the following IP address in dotted decimal format into Hexidecimal representation. (6%)

94.176.117.21

Correct answer: a. 01011110 10110000 01110101 00010101 = 5EB07515