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Academic Year: 2019-2020 Semester: Fall 2019

Date: Dec 2019 Level: Diploma

Course Title:	Course code:	Time:	Exam marks:	# Exam Sheets:
Introduction To Computer Science	CS500	2 Hours	100	1 (1 Page)

Exam Instructions: ANSWER ALL QUESTIONS STEP-BY-STEP

Question One: (15 Marks)

Draw a diagram illustrating the architecture of modern computers.

Question Two: (30 Marks)

Assuming a floating-point binary pattern represented in IEEE-32 notation, find the following:

a) Code the decimal value $(-431.390625)_{10}$. $(C3D7B200)_{16}$ **[10 Marks]**

b) Decode the pattern $(C3D1E000)_{16}$ to its equivalent decimal value. (-419.75) **[10 Marks]**

c) Decode the pattern $(7FA9B543)_{16}$ to its equivalent decimal value. **[10 Marks]**

1.325

Question Three: (10 Marks)

2.1 Find the decimal value of the binary number $(1111)_2$ in the following systems: **[6 Marks]**

a) Unsigned Integer 15

b) Signed-Magnitude. -7

c) Signed 1's Complement. -0

d) Signed 2's Complement. -1

e) Excess. +7

2.2 Assuming a signed 2's complement notation in 8-bits, calculate the following: **[4 Marks]**
(-127) – (+125).

Question Four: (45 Marks)

1.1 Convert **directly** the binary number $(1110110.1100011)_2$ to its equivalent numbers in the following number systems: **[9 Marks]**

(a) Base 4 (b) Octal (c) Hexadecimal

1.2 Calculate the following operations: **[36 Marks]**

a) 1101.11 + 11101.011

b) 11100.001 – 11010.11101 (Using Direct Subtraction)

c) 11101.01 – 11001.101 (Using 1's Complement)

d) 11010.11001 – 11100.00011 (Using 2's Complement)

{Question 2}

a) Code $(-431.390625)_{10}$

* number sign is ⊖ then first bit is 1

$(110101111.011001)_2$

$e = 1.f$

$= 1.10101111011001 \times 2^{+8}$

$= 8 + 127 = 135$

$135 = (10000111)_2$

exponant $= (10000111)_2$

1 (bit)	8 (bits)	23 (bits)
sign	exPonant	Fraction
1	10000111	10101111011001000000000

1100 0011 1101 0111 1011 0010 0000 0000

$(C\ 3\ D\ 7\ B\ 2\ 0\ 0)_{16}$

$\boxed{(C3D7B200)_{16}}$

{Question 2}

B) Decod $(C3D1E000)_{16}$

C	3	D	1	E	0	0	0
1100	0011	1101	0001	1110	0000	0000	0000

sign	exponant	Fraction
1	10000111	10100011110000000000000

* first bit is 1 → negative number

$e = (10000111)_2 = 135$

$e = 135 - 127 = +8$

$f = 1.f = 1.10100011111 \times 2^{+8}$

$= (110100011.11)_2$

$= \boxed{-419.75}$

{Question 2}

C) Decode $(7FA9B543)_{16}$

7	F	A	9	B	5	4	3
0111	1111	1010	1001	1011	0101	0100	0011

sign	exponant	Fraction
0	11111111	01010011011 010101000011

* its a special case exponant
= NaN (not a number) {reserved}

x 11111111

{ Question 3 }

Binary $(1111)_2$

$\boxed{3.1}$

a) unsigned

$n = 4$

* Rang $[0, +2^n - 1] = [0, 15]$

$= \boxed{15}$

B) Signed magnitude

* Range $[-(2^{n-1}-1), +(2^{n-1}-1)] = [-7, +7]$

$= -7$

C) Signed 1's Complement

sign -

* Rang $[-7, 7]$ * 1000 $= 0$

$= -0$

D) signed 2's Complement

sign -

* Range $[-8, 7]$ 1001 $= 1$

$= -1$

sign +

E) Excess

$1\,011$ 7

* Rang $[-8, 7]$

$= 15 - 8 = \boxed{+7}$

$x = 4$

$n - 1 = 4$

$n = 4 - 1$

$n = 3$

* Range =

$[-(2^{n-1}-1), +(2^{n-1}-1)]$

$= [-8, +7]$

{Question 3}

$\boxed{3.2}$ $(-127) - (+125)$.

assuming a signed 2's complement notation in 8 bits

* $(-127) - (+125) = (-127) + (-125)$.

* $(-127) + (-125) = -252$

* Calc Range $= [-(2^{n-1}), +(2^{n-1} - 1)]$

$= [-128, 127]$

-252 is not in range or out of range or overflow.

$-127 = 1111111$ 2's with sign $= 10000001$

$-125 = 1111101$ 2's with sign $= 10000011$

$$
\begin{array}{r}
10000001 \\
+\ 10000011 \\
\hline
\cancel{1}\ 00000100
\end{array}
$$

$= $ Positive number !!

* notice: in Lecture 2 Page 19 Slide 7
  - (a) When adding two Possitive numbers, the result is negative
  - (b) When adding two negative numbers, the result is Possitive

overflow Problem

{Question 4}

1.1 $(1110110.1100011)_2$

a) to base 4 $n = 2$ bits $(0, 1, 2, 3)$

$$\underbrace{01}\ \underbrace{11}\ \underbrace{01}\ \underbrace{10}\ .\ \underbrace{11}\ \underbrace{00}\ \underbrace{01}\ \underbrace{10}$$

$$(1\ 3\ 1\ 2\ .\ 3\ 0\ 1\ 2)_4$$

b) to base 8 (octal) $n = 3$ bits $(0, 1, 2, 3, 4, 5, 6, 7)$

$$\underbrace{001}\ \underbrace{110}\ \underbrace{110}\ .\ \underbrace{110}\ \underbrace{001}\ \underbrace{100}$$

$$(1\ 6\ 6\ .\ 6\ 1\ 4)_8$$

c) to base 16 (Hexadecimal) $n = 4$ bits
$(0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F)$

$$\underbrace{0111}\ \underbrace{0110}\ .\ \underbrace{1100}\ \underbrace{0110}$$

$$(7\ 6\ .\ C\ 6)_{16}$$

Question 4 $\boxed{1.2}$

a)

$$\begin{array}{r} 01101.111 \\ +\ 11101.011 \\ \hline \boxed{101011.010} \end{array}$$

101011.010

b)

$$\begin{array}{r} 11100.00100 \\ -\ 11010.11101 \\ \hline \boxed{00001.00111} \end{array}$$

1.00111

c)

$$\begin{array}{r} 11101.010 \\ +\ 00110.010 \\ \hline \boxed{1}\,00011.100 \\ +\ 1 \\ \hline 00011.101 \end{array}$$

00011.101 → 11.101

D)

$$\begin{array}{r} 11010.11001 \\ +\ 00011.11101 \\ \hline \boxed{\cancel{0}}\,11110.10110 \end{array}$$

its a negative number

-00001.01010

-1.0101