Cairo University	**Cairo University** **Institute Of Statistical Studies And Researches**	
	Department: Computer Science	
	Academic Year: 2016-2017 **Semester:** First	
	Date: 29/11/2016 **Level:** Diploma	

Course Title:	**Course code:**	**Time:**	**Exam marks:**	**# Exam. Sheets:**
Introduction To Computer Science	CS500	90 Min	25	1 Page

Exam. Instructions : ANSWER ALL QUESTIONS

Question One: (6 Marks)

Convert the decimal number $(22.65625)_{10}$ to its equivalent numbers in the following systems:

Hint: Perform Direct Conversion From Binary To Octal And Hexadecimal

(a) Binary

(b) Octal

(c) Hexadecimal

(d) Base 4

Solution:

(a) $(22.65625)_{10} = (10110.10101)_2$

$22 \div 2 = 11$	0		$0.65625 \times 2 = 1.3125$		1
$11 \div 2 = 5$	1		$0.3125 \times 2 = 0.625$		0
$5 \div 2 = 2$	1		$0.625 \times 2 = 1.25$		1
$2 \div 2 = 1$	0		$0.25 \times 2 = 0.5$		0
$1 \div 2 = 0$	1		$0.5 \times 2 = 1.0$		1

(b) $(22.65625)_{10} = (\underline{010}\ \underline{110} . \underline{101}\ \underline{010})_2 = (26.52)_8$

(c) $(22.65625)_{10} = (\underline{0001}\ \underline{0110} . \underline{1010}\ \underline{1000})_2 = (16.A8)_{16}$

(d) $(22.65625)_{10} = (112.222)_4$

$22 \div 4 = 5$	2		$0.65625 \times 4 = 2.625$		2
$5 \div 2 = 2$	1		$0.625 \times 4 = 2.5$		2
$1 \div 2 = 0$	1		$0.5 \times 4 = 2.0$		2

Or because $4 = 2^2$***, group each two binary bits into a single digit in base 4***

$(22.65625)_{10} = (\underline{01}\ \underline{01}\ \underline{10} . \underline{10}\ \underline{10}\ \underline{10})_2 = (122.222)_4$

Question Two: (5 Marks)

Find the decimal value of the binary number $(10000)_2$ in the following notations:

(a) Unsigned Integer

(b) Signed-Magnitude

(c) Signed 1's Complement

(d) Signed 2's Complement

Best Wishes ☺

Dr./Ahmed Hamza

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(e) Excess

Solution:

(a) $(10000)_2 = (1 * 2^4 + 0 * 2^3 + 0 * 2^2 + 0 * 2^1 + 0 * 2^0) = (16)_{10}$

(b) $(10000)_2 = (1)_{sign}$ **and** $(0000)_{magnitude} = (-0)_{10}$

(c) $(10000)_2 = (01111)_{1\text{'s complement}} = (-15)_{10}$

(d) $(10000)_2 = (10000)_{2\text{'s complement}} = (-16)_{10}$

(e) $(10000)_2 = (16)_{Unsigned\ Integer} - 16 = (0)_{10}$ ***, Use Excess-16 because excess number is in 5-bits.***

Question Three: (8 Marks)

Calculate the following operations:

(a) 11100.001 – 11010.11101 (Direct Subtraction)

(b) 13.625 – 27.750 (Using 10's complement)

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

(d) (+4) + (+5) (Assuming 2's complement addition in 4-bits)

Solution:

```
            1 1   1 1 2 1
          0 2 2   2 2 0 2 2
(a)     1 1 1 0 0 . 0 0 1 0 0
    –   1 1 0 1 0 . 1 1 1 0 1
        ---------------------
        0 0 0 0 1 . 0 0 1 1 1
```

```
(b)     1 3 . 6 2 5
     -  2 7 . 7 5 0
       1 3 . 6 2 5
     + 7 2 . 2 5 0   (10's complement of 27.750)
       8 5 . 8 7 5   Because no carry, so the result is (the negative of the 10's complement of 85.875)
     - 1 4 . 1 2 5   (10's complement of 85.875)
```

```
(c)     1 1 1 0 1 . 0 1 0
      - 1 1 0 0 1 . 1 0 1
        1 1 1 0 1 . 0 1 0
      + 0 0 1 1 0 . 0 1 0   (1's complement of 11001.101)
       1 0 0 0 1 1 . 1 0 0
      +                   1
```

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0 0 0 1 1 . 1 0 1

(d) (+4) + (+5) = (+9)

But the decimal range of 2's complement in 4-bits range $= -(2^{n-1})$ *To* $+(2^{n-1} - 1)$

$= -(2^{4-1})$ *To* $+(2^{4-1} - 1)$

$= -(2^{3})$ *To* $+(2^{3} - 1)$

$= -8$ *To* $+7$

$= [-8 , +7]$

Because the decimal result is +9 which is out of range, +9 > +7, so the result is overflow

Question Four: (6 Marks)

Assuming a floating-point binary pattern in **excess-8** notation of length 12-bits with 1-bit for a sign, 4-bits for exponent and 7-bits for fraction. Find the following:

(a) Code the decimal value $(-43.5)_{10}$.

(b) Decode the bit pattern $(111111111111)_2$ to its equivalent decimal value.

Solution:

(a) $(-43.5)_{10} = (- 101011.1)_2$

43 ÷ 2 = 21	*1*	*0.5 * 2 = 1.0*	*1*
21 ÷ 2 = 10	*1*		
10 ÷ 2 = 5	*0*		
5 ÷ 2 = 2	*1*		
2 ÷ 2 = 1	*0*		
1 ÷ 2 = 0	*1*		

$- 101011.1 = - .1010111 * 2^{+6}$

Exponent (e) = $(+6)_{10}$ ➡ *Exponent (e) = (+6) + 8 =* $(+14)_{Excess-8} = (1110)_2$

14 ÷ 2 = 7	*0*
7 ÷ 2 = 3	*1*
3 ÷ 2 = 1	*1*
1 ÷ 2 = 0	*1*

Fraction (f) = $(.1010111)_2$

Sign (s) = $(1)_2$

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s (1-bit)	*e (4-bit)*	*f (7-bit)*
1	*1110*	*1010111*

(b) Divide $(111111111111)_2$ into s(1-bit), e(4-bit) and f(7-bit)

s (1-bit)	*e (4-bit)*	*f (7-bit)*
1	*1111*	*1111111*

$s = (1)_2 =$ *- (negative)*

$f = (.1111111)_2$

$e = (1111)_2 = (+15)_{Excess\text{-}8} = (+15) - 8 = (+7)_{10}$

$$-.1111111 * 2^{+7} = (- 1111111.0)$$
$$= - (64 + 32 + 16 + 8 + 4 + 2 + 1)$$
$$= (-127)_{10}$$

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