



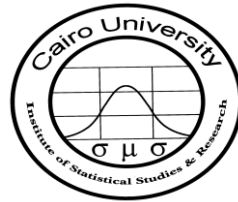
Cairo University

Cairo University
Institute Of Statistical Studies And Researches

Department: Computer Science

Academic Year: 2016-2017 **Semester:** First

Date: 29/11/2016 **Level:** Diploma



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|--|------------------------------|------------------------|--------------------------|----------------------------------|
| Course Title: Introduction To Computer Science | Course code: CS500 | Time: 90 Min | Exam marks: 25 | # Exam. Sheets: 1 Page |
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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) $(22.65625)_{10} = (010\ 110 . 101\ 010)_2 = (26.52)_8$

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

(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

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

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

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Exam. Instructions : ANSWER ALL QUESTIONS

Solution:

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

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

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

(d) $(10000)_2 = (10000)_2$'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:

$$\begin{array}{r} \overset{1}{\cancel{0}} \overset{1}{\cancel{2}} \overset{1}{\cancel{2}} \overset{1}{\cancel{0}} \overset{2}{\cancel{2}} \overset{1}{\cancel{0}} \overset{1}{\cancel{2}} \overset{1}{\cancel{0}} \\ (a) \quad 111000.001000 \\ - \quad 110100.111010 \\ \hline 00001.001110 \end{array}$$

(b) 13.625

- 27.750

13.625

$$+ 72.250 \text{ (10's complement of 27.750)}$$

85.875 Because no carry, so the result is (the negative of the 10's complement of 85.875)

- 14.125 (10's complement of 85.875)

(c) 11101.010

- 11001.101

1 1 1 0 1 . 0 1 0

$$+ 00110.010 \text{ (1's complement of } 11001.101)$$

$$\underline{100011.100}$$

$$+ \quad \rightarrow \quad 1$$

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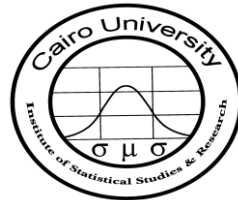
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Exam. Instructions : ANSWER ALL QUESTIONS

0 0 0 1 1 . 1 0 1

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

But the decimal range of 2's complement in 4-bits range $= -(2^{n-1}) \text{ To } +(2^{n-1} - 1)$
 $= -(2^{4-1}) \text{ To } +(2^{4-1} - 1)$
 $= -(2^3) \text{ To } +(2^3 - 1)$
 $= -8 \text{ To } +7$
 $= [-8, +7]$

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

| | | | |
|------------------|-----|-----------------|-----|
| $43 \div 2 = 21$ | 1 | $0.5 * 2 = 1.0$ | 1 |
| $21 \div 2 = 10$ | 1 | | |
| $10 \div 2 = 5$ | 0 | | |
| $5 \div 2 = 2$ | 1 | | |
| $2 \div 2 = 1$ | 0 | | |
| $1 \div 2 = 0$ | 1 | | |

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

Exponent (e) = $(+6)_{10}$ \longrightarrow Exponent (e) = $(+6) + 8 = (+14)_{\text{Excess-8}} = (1110)_2$

| | |
|-----------------|-----|
| $14 \div 2 = 7$ | 0 |
| $7 \div 2 = 3$ | 1 |
| $3 \div 2 = 1$ | 1 |
| $1 \div 2 = 0$ | 1 |

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

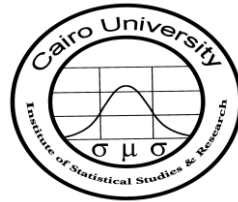
Sign (s) = $(1)_2$

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|------------------|------------------|------------------|
| <i>s (1-bit)</i> | <i>e (4-bit)</i> | <i>f (7-bit)</i> |
| <i>1</i> | <i>1110</i> | <i>1010111</i> |

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

| | | |
|------------------|------------------|------------------|
| <i>s (1-bit)</i> | <i>e (4-bit)</i> | <i>f (7-bit)</i> |
| <i>1</i> | <i>1111</i> | <i>1111111</i> |

$$s = (1)_2 = - \text{(negative)}$$

$$f = (.1111111)_2$$

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

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

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