**HOMEWORK I DUE: 26 October 2017**

1. Express the following numbers in decimal:

   a. $(1100110.110)_2$

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 0 | 0 | 1 | 1 | 0 | . | 1 | 1 | 0 |
| $2^6$ | $2^5$ | $2^4$ | $2^3$ | $2^2$ | $2^1$ | $2^0$ | . | $2^{-1}$ | $2^{-2}$ | $2^{-3}$ |
| 64 | 32 | 0 | 0 | 4 | 2 | 0 | . | 0.5 | 0.25 | 0 |
| | | | **102** | | | | **.** | | **75** | |

   b. $(743.50)_8$

| | | | | | |
|---|---|---|---|---|---|
| 7 | 4 | 3 | . | 5 | 0 |
| $8^2$ | $8^1$ | $8^0$ | . | $8^{-1}$ | $8^{-2}$ |
| 64 | 8 | 1 | . | 0.125 | 0.0156 |
| 7x64 | 4x8 | 3x1 | . | 5x0.125 | 0x0.0156 |
| 448 | 31 | 3 | . | 0.625 | 0 |
| | 448+31+3 | | . | 0.625 | |
| | **480** | | **.** | **625** | |

**(10 pts)**

2. Express $(3249)_{10}$, $(258)_{10}$, $(71)_{10}$, in
   a. BCD
   b. Excess-3
   c. 2421

**(15 pts)**

| Decimal | 3 | 2 | 4 | 9 |
|---|---|---|---|---|
| BCD | **0011** | **0010** | **0100** | **1001** |
| Excess-3 | **0110** | **0101** | **0111** | **1100** |
| 2421 | **0011** | **0010** | **0100** | **1111** |

| Decimal | 2 | 5 | 8 |
|---|---|---|---|
| BCD | **0010** | **0101** | **1000** |
| Excess-3 | **0101** | **1000** | **1011** |
| 2421 | **0010** | **1011** | **1110** |

| Decimal | 7 | 1 |
|---|---|---|
| BCD | **0111** | **0001** |
| Excess-3 | **1010** | **0100** |
| 2421 | **1101** | **0001** |

3. Using **<u>10's complement</u>**, perform the subtraction operation on the following unsigned numbers:

   a. 9875 – 1234

| | | | | | | |
|---|---|---|---|---|---|---|
| 10's complement of 1234 is | | | 9 | 9 | 9 | 10 |
| | | | 1 | 2 | 3 | 4 |
| | | | **8** | **7** | **6** | **6** |
| Add 8766 to 9875 | | | 9 | 8 | 7 | 5 |
| | **+** | | 8 | 7 | 6 | 6 |
| | | **1** | **8** | **6** | **4** | **1** |
| Discard the end carry | - | 1 | 0 | 0 | 0 | 0 |
| | | | **8** | **6** | **4** | **1** |

b. 130 – 200

| | | | | |
|---|---|---|---|---|
| 10's complement of 200 is | | 10 | 0 | 0 |
| | | 2 | 0 | 0 |
| | | **8** | **0** | **0** |
| Add 800 to 130 | | 1 | 3 | 0 |
| | **+** | 8 | 0 | 0 |
| | | **9** | **3** | **0** |
| As M<N take 10s' comp of 920 | | 9 | 10 | 0 |
| | | 9 | 3 | 0 |
| | | **-** | **7** | **0** |

**(10 pts)**

4. Convert the following decimal numbers **60** and **34** to binary using the **signed 2's complement** representation and **enough digits** to accommodate numbers. Then perform the binary equivalent of **(+60) + (-34)**, **(-60) + (+34)** and **(-60) + (-34)**.

**(15 pts)**

| 60 | 2 = | 30 | 0 |
|---|---|---|---|
| 30 | 2 = | 15 | 0 |
| 15 | 2 = | 7 | 1 |
| 7 | 2 = | 3 | 1 |
| 3 | 2 = | 1 | 1 |
| 1 | 2 = | 0 | 1 |

$60 = (\mathbf{11110})_2$

| 34 | 2 = | 17 | 0 |
|---|---|---|---|
| 17 | 2 = | 8 | 1 |
| 8 | 2 = | 4 | 0 |
| 4 | 2 = | 2 | 0 |
| 2 | 2 = | 1 | 0 |
| 1 | 2 = | 0 | 1 |

$34 = (\mathbf{100010})_2$

Therefore for sign 2's complement representation of

| | | | |
|---|---|---|---|
| +60 | **0111100** | -60 | **1000100** |
| +34 | **0100010** | -34 | **1011110** |

| | |
|---|---|
| (+ 60) | **0111100** |
| + (- 34) | **1011110** |
| (+26) | ~~**1**~~**0011010** most significant bit is discarded. |

| | |
|---|---|
| (- 60) | **1000100** |
| + (+ 34) | **0100010** |
| (- 26) | **1100110** signed 2's complement of -26. |

| | |
|---|---|
| (- 60) | **1000100** |
| + (- 34) | **1011110** |
| (- 94) | **10100010** |
| | **-01011110** take the 2's comp of 10100010 put (-) sign in front |

5. Convert the following binary number to **Octal** and to **Hexadecimal**:

   a. $(1011001.1011001)_2$

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| octal | *00*1 | 011 | 001 | . | 101 | 100 | 1*00* |
| | **1** | **3** | **1** | **.** | **5** | **4** | **4** |
| hexadecimal | | *0*101 | 1001 | . | 1011 | 001*0* | |
| | | **5** | **9** | **.** | **B** | **2** | |

**(5 pts)**

6. Convert the following **Hexadecimal** number to **Octal**:

   a. $(6F9E1A.5C2B)_{16}$

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | F | 9 | E | 1 | A | . | 5 | C | 2 | B | |
| 0110 | 1111 | 1001 | 1110 | 0001 | 1010 | . | 0101 | 1100 | 0010 | 1011 | |
| 011 | 011 | 111 | 001 | 111 | 000 | 011 | 010 | . | 010 | 111 | 000 | 010 | 101 | 1*00* |
| **3** | **3** | **7** | **1** | **7** | **0** | **3** | **2** | **.** | **2** | **7** | **0** | **2** | **5** | **4** |

**(5 pts)**

7. Using **10's complement**, consider the **BCD** addition of (+82) + (-231).

| | | | | |
|---|---|---|---|---|
| 10'S complement of -231 | 9 | 9 | 9 | 10 |
| | 0 | 2 | 3 | 1 |
| | **9** | **7** | **6** | **9** |
| Add 9769 to 0082 | **0** | **0** | **8** | **2** |
| | **9** | **7** | **6** | **9** |
| 2's comp of 149 | **9** | **8** | **5** | **1** |

**(10 pts)**

8. The following is a string of ASCII characters whose bit patterns have been converted into hexadecimal for compactness: 4D 6F CF 72 C5 AC F3 A0 CC 41 D7. Of the 8 bits in each pair of digits, the leftmost is a parity bit. The remaining bits are the ASCII code.

   a. Convert to bit form and decode the ASCII.

| Hex | Parity | ASCII | | Hex | Parity | ASCII | |
|---|---|---|---|---|---|---|---|
| **4D** | 0 | 100 1101 | **M** | **F3** | 1 | 111 0011 | **s** |
| **6F** | 0 | 110 1111 | **o** | **A0** | 1 | 010 0000 | **SP** |
| **CF** | 1 | 100 1111 | **O** | **CC** | 1 | 100 1100 | **L** |
| **72** | 0 | 111 0010 | **r** | **41** | 0 | 100 0001 | **A** |
| **C5** | 1 | 100 0101 | **E** | **D7** | 1 | 101 0111 | **W** |
| **AC** | 0 | 110 0000 | **`** | | | | |

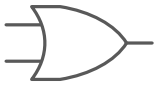
   b. Determine the parity used: odd or even.

   **EVEN**

**(20 pts)**

9. Derive the truth table for **2-input AND** and **OR** functions and show their logic symbols.

**(10 pts)**

| **AND** | | | | **OR** | | | |
|---|---|---|---|---|---|---|---|
| A | B | F | | A | B | F | |
| 0 | 0 | 0 |  | 0 | 0 | 0 |  |
| 0 | 1 | 0 | | 0 | 1 | 1 | |
| 1 | 0 | 0 | | 1 | 0 | 1 | |
| 1 | 1 | 1 | | 1 | 1 | 1 | |