**Part III. Binary/Hexadecimal/Decimal Conversions**

For the exam, you should be able to convert between any of these number systems.

Binary – You will be given an 8 digit binary number, built with only 1s and 0s. Each of the 8 numbers represents a different value in decimal, our number system. With 8 binary digits, you can create decimal numbers in the range from 0 to 255.

128 64 32 16 8 4 2 1

**Conversion # 1** – Binary to Decimal: Put 8 binary digits under the 8 values above. Add the #s that have a 1 under them.

Ex: Convert 10001101 to decimal.

128 64 32 16 8 4 2 1

1 0 0 0 1 1 0 1

In this example, the 1s fall under the 128, 8, 4 and 1 columns, so we simply add those numbers together

128 + 8 + 4 + 1 = 141, so binary 10001101 = **141** (decimal.)

**Conversion # 2** – Decimal to Binary: Starting with 128, subtract the 8 values from the decimal, as long as result is not negative. If you can do it, put a 1 in that column. Should hit 0 in the end if done correctly.

Ex: Convert 189 to binary

* We can subtract 128 from 189, so we put a 1 in the 128 column and have 61 remaining (189-128)
* We cannot subtract 64 from 61 (We would go negative), so we put a 0 in the 64 column
* We can subtract 32 from 61, so we put a 1 in the 32 column and have 29 left.
* We can subtract 16 from 29, so we put a 1 in the 16 column and have 13 left.
* We can subtract 8 from 13, so we put a 1 in the 8 column and have 5 left.
* We can subtract 4 from 5, so we put a 1 in the 4 column and have 1 left.
* We cannot subtract 2 from 1, so we put a 0 in the 2 column.
* We can subtract 1 from 1, so we put a 1 in the 1 column and have 0 left.

The answer is **10111101**

Hexadecimal is a common number system used in the IT field. It has 16 different symbols used to express numbers. It uses 0 to 9, as well as the letters A through F. The value of each letter is as follows:

A = 10 B = 11 C = 12 D = 13 E = 14 F = 15

**Conversion # 3** – Binary to Hex: The conversion from binary to hex is easy. The rule to remember is that 4 binary digits = 1 hex digit. Since we give binary in 8 bit chunks, they can always be converted into 2 hex digits. The key is to split the binary in 4 bit chunks. Convert each chunk to a value 0 to 15. If the result is greater than 9, be sure to use the above conversions to express the letter A through F.

Ex: Convert 10100101 to Hex.

Split the binary in 4 bit chunks: 1010 and 0101

Convert each 4 bit chunk separately using: 8 4 2 1 as the column place values

**8 4 2 1 8 4 2 1**

1 0 1 0 0 1 0 1

8 + 2 = 10 4 + 1 = 5

10=A 5

Answer: 10100101 = **A5** (hex)

**Conversion # 4** – Hex to Binary: Another easy conversion. Treat each hex digit as a number 0 to 15. Convert each number to a 4 digit binary number. Glue to two together to get your final answer:

Ex: Convert D9 to binary.

D = 13 9

8 4 2 1 8 4 2 1

1 1 0 1 1 0 0 1

Answer: 11011001 = D9

**Conversion # 5** – Decimal to Hex: Use conversion # 2 to get from decimal to binary, then conversion # 4 to get from binary to hex.

Ex: Convert 203 to Hex.

203 decimal converts to binary:

128 64 32 16 8 4 2 1

1 1 0 0 1 0 1 1

11001011 binary converts to hex:

8 4 2 1 8 4 2 1

1 1 0 0 1 0 1 1

12 11

C B

So 203 decimal = **CB** (hex)

**Conversion # 6** – Hex to Decimal: Use conversion # 4 to get from hex to binary, then conversion # 1 to get from binary to decimal.

Ex: Convert 8F to decimal.

8F converts to binary:

8 F = 15

1000 1111

Then convert 10001111 to decimal

128 64 32 16 8 4 2 1

1 0 0 0 1 1 1 1

128+8+4+2+1 = 143

8F = **143** (decimal)