**Name: - Shahrukh Padaniya**

**Student number: - C0769542**

**ESE-2005 Assignment 1 Number system**

**Exercise**

**1. An analog voltage is in the range of 0–5V. If it can be measured with an accuracy of ± 50mV, at most how many bits of information does it convey?**

Answer: -

The range is 5v and the accuracy is 0.05v,

So, by dividing them, we get 100.

Therefore, we need 7 bits to convey the information.

**2. What is the largest 8-bit binary number that can be represented with**

**(a) unsigned numbers?**

For unsigned number, the range is from 0 to 2N-1, so the highest number with n=8 will be 255.

**(b) two’s complement numbers?**

For two’s complement the range is from -2N-1 +1 to 2N-1-1, so the highest number with n=8 will be 127.

**(c) sign/magnitude numbers?**

For signed number, the range is from -2N-1  to 2N-1-1, so the highest number with n=8 will be 127.

**3. Convert the following unsigned binary numbers to decimal. Show your process.**

**(a) 10102**

1x23+0x22+1x21+0x20

= 8+2

=10

**(b) 1101102**

1x25+1x24 +0x23+1x22+1x21+0x20

= 32+16+4+2

=54

**(c) 111100002**

1x27+1x26 +1x25+1x24 +0x23+0x22+0x21+0x20

= 128+64+32+16

=240

**(d) 0001000101001112**

0x214+0x213 +0x212+1x211 +0x210+0x29+0x28+1x27+0x26 +1x25+0x24 +0x23+1x22+1x21+1x20

= 2048+128+32+4+2+1

= 2215

**4. Convert the following unsigned binary numbers to hexadecimal. Show your process.**

**(a) 10102**

Group in pair of 4 from right.

=A

**(b) 1101102**

=0011 0110

=36

**(c) 111100002**

=1111 0000

=F0

**(d) 0001000101001112**

=000 1000 1010 0111

=08A7

**5. Convert the following hexadecimal numbers to decimal. Show your process.**

**(a) 4E16**

=4x161 +Ex160

=64+14

=78

**(b) 7C16**

=7x161 +Cx160

=112+12

=124

**(c) ED3A16**

=Ex163 +Dx162+3x161 +Ax160

=57344+3328+48+10

=60730

**(d) 403F B00116**

= 4x167 +0x166+3x165 +Fx164 Bx163 +0x162+0x161 +1x160

=1077915649

**6. Convert the following two’s complement binary numbers to decimal.**

**(a) 11002**

Change bit- 0011

Add 1= 0100

=1x22

=4

**(b) 1000012**

Change bit- 011110

Add 1= 011111

=0x25+1x24 +1x23+1x22+1x21+1x20

= 16+8+4+2+1

=31

**(c) 010011002**

Change bit- 10110011

Add 1= 10110100

=1x27+0x26 +1x25+1x24 +0x23+1x22+0x21+0x20

= 128+32+16+4

=180

**(d) 101101012**

Change bit- 01001010

Add 1= 01001011

=0x27+1x26 +0x25+0x24 +1x23+0x22+1x21+1x20

= 75

**7. A particular DSL modem operates at 768 kbits/sec. How many bytes can it receive in 1 minute? USB 3.0 can send data at 5 Gbits/sec. How many bytes can it send in 1 minute?**

a) 8 bits =1 byte

Therefore, 768k bits = x bytes

So x=768k/8= 96 kbytes/sec

So for bytes/min = 9.6 kbytes x 60 =5760 Kbytes/min.

b) 8 bits =1 byte

Therefore, 5 Gbits = x bytes

So x=5Gbits/8= 0.625 Gbytes/sec

So for bytes/min = 0.625 Gbytes x 60 =37.5 Gbytes/min.

**8. Estimate the value of 231 without using a calculator. Show your process.**

Firstly 231 is more than 27 and less then 28, so we take 27 (128) as 1, MSB.

231-128=103

So, we take second next bit as 26 as 1

103-64=39

So, next bit 25 as 1

39-32=7

In same way 22,21,20 as 1

1100111

**9. Perform the following additions of unsigned binary numbers. Indicate whether or not the sum overflows an 8-bit result.**

**(a) 100110012**

**+ 010001002**

=11011101

The sum does not overflow an 8 bit result.

**(b) 110100102**

**+ 101101102**

= 010001000

The result does overflow an 8 bit result.

**10. Perform the following additions of two’s complement binary numbers. Indicate whether or not the sum overflows an 8-bit result.**

**(a) 100110012+ 010001002**

Taking 2’s complement of 2nd number= 10111011

+1

= 10111100

Adding both numbers: - 10011001+10111100= 1 01010101

Therefore, the sum overflow.

**(b) 110100102 + 101101102**

Taking 2’s complement of 2nd number= 01001001

+1

= 01001010

Adding both numbers: - 11010010+01001010= 1 00011100

Therefore, the sum overflow.