IS 201

Tutorial –(3.a)

FIRST Semester 1438-1439

For Sections

31275 and 31279

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**Q1.Convert the following numbers from binary (base2) to decimal (base 10).**

1. $(11111)\_{2}$ **b.**$(101010)\_{2}$ **c.**$(110011.001)\_{2}$ **d.**$(101011.0001)\_{2}$

**Answer:**

a.$(11111)\_{2}$

**1**\*24 + **1**\*23 + **1**\*22 + **1**\*21 + **1**\*20 =

1\*16 + 1\*8 + 1\*4 + 1\*2 + 1\*1 =

16+8 + 4 + 2 + 1 =

**31, hence** $(31)\_{10}$ **is equivalent to** $(11111)\_{2}$

b.$(101010)\_{2}$

**1**\*25 + **0**\*24 + **1**\*23 + **0**\*22 + **1**\*21 + **0**\*20 =

1\*32 + 0\*16 + 1\*8 + 0\*4 + 1\*2 + 0\*1 =

32 + 0 + 8 + 0 + 2+ 0 =

**42, hence** $(42)\_{10}$ **is equivalent to** $(101010)\_{2}$

c.$(110011.001)\_{2}$

**1**\*25 + **1**\*24 + **0**\*23 + **0**\*22 +**1**\*21 + **1**\*20 +**0**\*2-1 + 0\*2-2 + **1**\*2-3 =

1\*32 + 1\*16 + 0\*8 + 0\*4 + 1\*2 + 1\*1 + 0\*.5 + 0\*.25 + 1\*.125 =

32 + 16 + 0 + + 0 + 2 + 1+ 0 + 0 + .125 =

**51.125, hence** $(51.125)\_{10}$ **is equivalent to** $(110011.001)\_{2}$

d. $(101011.0001)\_{2}$

**1**\*25 + **0**\*24 + **1**\*23 + **0**\*22 +**1**\*21 + **1**\*20 +**0**\*2-1 + **0**\*2-2 + **0**\*2-3 + **1**\*2-4 =

1\*32 + 0\*16 + 1\*8 + 0\*4 + 1\*2 + 1\*1 + 0\*.5 + 0\*.25 + 0\*.125 + 1\*.0625 =

32 + 0 + 8 + 0 + 2 + 1 + 0 + 0 + 0 +0.0625 =

**43.0625, hence** $(43.0625)\_{10}$ **is equivalent to** $(101011.0001)\_{2}$

**Q2.Convert the following numbers from octal (base 8) to decimal (base 10).**

1. $(145)\_{8}$ **b.**$(235)\_{8}$ **c.**$(39.01)\_{8}$ **d.**$(123.48)\_{8}$

**Answer:**

a.$(145)\_{8}$

**1**\*82 + **4**\*81 + **5**\*80 =

1\*64 + 4\*8 + 5\*1 =

64+32 + 5 =

**101, hence** $(101)\_{10}$ **is equivalent to** $(145)\_{8}$

b.$(235)\_{8}$

**2**\*82 + **3**\*81 + **5**\*80 =

2\*64 + 3\*8 + 5\*1 =

128 + 24 + 5 =

**157, hence** $(157)\_{10}$ **is equivalent to** $(235)\_{8}$

c.$(39.01)\_{8}$

**3**\*81 + **9**\*80 +**0**\*8-1 + 1\*8-2 =

3\*8 + 9\*1 + 0\*.125 + 1\*.015625 =

24 + 9 + 0 +.015625 =

**33.015625, hence** $(33.015625)\_{10}$ **is equivalent to** $(39.01)\_{8}$

d. $(123.48)\_{8}$

**1**\*82 + **2**\*81 + **3**\*80 + **4**\*8-1 + **8**\*8-2 =

1\*64 + 2\*8 + 3\*1 + 4\*.125 + 8\*.015625 =

64 + 16 + 3 + 0.5 + 0.125 =

**83.625, hence** $(83.625)\_{10}$ **is equivalent to** $(123.48)\_{8}$

**Q3. Convert the following numbers from hex (base 16) to decimal (base 10).**

**a.**$(A5B)\_{16}$ **b.**$(209E)\_{16}$ **c.**$(1F.8A)\_{16}$ **d.**$(1A8.28)\_{16}$

**Answer:**

a.$(A5B)\_{16}\_{}$

**A**\*162 + **5**\*161 + **B**\*160 =

10\*256 + 5\*16 + 11\*1 =

2560+80 + 11 =

**2651, hence** $(2651)\_{10}$ **is equivalent to** $(A5B)\_{16}$

b.$(209E)\_{16}$

**2**\*163 + **0**\*162+ **9**\*161 + **E**\*160 =

2\*4096 + 0\*256 + 9\*16 + 14\*1 =

8192 + 0 + 144 + 14 =

**8350, hence** $(8350)\_{10}$ **is equivalent to** $(209E)\_{16}$

c.$(1F.8A)\_{16}$

**1**\*161 + **F**\*160 +**8**\*16-1 + A\*16-2 =

1\*16 + 15\*1 + 8\*.0625 + 10\*.00390625 =

16 + 15 + 0.5 + 0.0390625 =

**31.5390625, hence** $(33.015625)\_{10}$ **is equivalent to** $(1F.8A)\_{16}$

d. $(1A8.28)\_{16}$

**1**\*162 + **A**\*161 + **8**\*160 + **2**\*16-1 + **8**\*16-2 =

1\*256 + 10\*16 + 8\*1 + 2\*.0625 + 8\*.00390625 =

256 + 160 + 8 + 0.125 + 0.03125 =

**424.15625, hence** $(424.15625)\_{10}$ **is equivalent to** $(1A8.28)\_{16}$

**Q4. Convert the following decimal numbers (base 10) into binary (base 2).**

**a.**$(22)\_{10}$ **b.**$(31)\_{10}$ **c.**$(99)\_{10}$ **d.**$(108)\_{10}$

**Answer**:

1. **Converting the decimal number 22 into binary:**

**First Step**: **Divide** the integer part **by** the base(**2**), and **keep the remainder** after each division.

**Stop** dividing when the integer part reaches zero.

|  |  |  |  |
| --- | --- | --- | --- |
| Number/base | Integer Part | Remainder | Remark |
| **22**/2 | 11 | **0** | **22**=11\*2 +0 |
| **11**/2 | 5 | **1** | **11**=5\*2 + 1 |
| **5**/2 | 2 | **1** | **5**= 2\*2 + 1  |
| **2**/2 | 1 | **0** | **2**= 1\*2 + 0 |
| **1**/2 | 0 | **1** | **1**= 0\*2 + 1 |

**Second Step**: **Concatenate** the **remaindersbottom-up**.

Thus the decimal number **22** is translated into the binary number **10110**

 **Hence ,2210 = 101102**

1. **Converting the decimal number 31 into binary:**

**First Step**: **Divide** the integer part **by** the base (**2**), and **keep the remainder** after each division.

**Stop** dividing when the integer part reaches zero.

Cont’d Answer to question 4.b on next page (page 5)

Answer to Q4.b cont’d:

|  |  |  |  |
| --- | --- | --- | --- |
| Number/base | Integer Part | Remainder | Remark |
| **31**/2 | 15 | **1** | **31**=15\*2 +1 |
| **15**/2 | 7 | **1** | **15**=7\*2 + 1 |
| **7**/2 | 3 | **1** | **7**= 3\*2 + 1  |
| **3**/2 | 1 | **1** | **3**= 1\*2 + 1 |
| **1**/2 | 0 | **1** | **1**= 0\*2 + 1 |

**Second Step**: **Concatenate** the **remaindersbottom-up**.

Thus the decimal number **31** is translated into the binary number **11111**

 **Hence, 3110 = 111112**

1. **Converting the decimal number 99 into binary:**

**First Step**: **Divide** the integer part **by** the base (**2**), and **keep the remainder** after each division.

**Stop** dividing when the integer part reaches zero.

|  |  |  |  |
| --- | --- | --- | --- |
| Number/base | Integer Part | Remainder | Remark |
| **99**/2 | 49 | **1** | **99**=49\*2 + 1 |
| **49**/2 | 24 | **1** | **49**=24\*2 + 1 |
| **24**/2 | 12 | **0** | **24**= 12\*2+ 0  |
| **12**/2 | 6 | **0** | **12**= 6\*2 + 0 |
| **6**/2 | 3 | **0** | **6** = 3\*2 + 0 |
| **3**/2 | 1 | **1** | **3** = 1\*2 + 1 |
| **1**/2 | 0 | **1** | **1** = 0\*2 + 1 |

**Second Step**: **Concatenate** the **remaindersbottom-up**.

Thus the decimal number **99** is translated into the binary number **1100011**

 **Hence ,9910 = 11000112**

**Cont’d; Answer to Q4.d:**

1. **Converting the decimal number 108 into binary:**

**First Step**: **Divide** the integer part **by** the base (**2**), and **keep the remainder** after each division.

**Stop** dividing when the integer part reaches zero.

|  |  |  |  |
| --- | --- | --- | --- |
| Number/base | Integer Part | Remainder | Remark |
| **108**/2 | 54 | **0** | **108**=54\*2+ 0 |
| **54**/2 | 27 | **0** | **54**=27\*2 + 0 |
| **27**/2 | 13 | **1** | **27**= 13\*2+ 1  |
| **13**/2 | 6 | **1** | **13**= 6\*2 + 1 |
| **6**/2 | 3 | **0** | **6** = 3\*2 + 0 |
| **3**/2 | 1 | **1** | **3** = 1\*2 + 1 |
| **1**/2 | 0 | **1** | **1** = 0\*2 + 1 |

**Second Step**: **Concatenate** the **remaindersbottom-up**.

Thus the decimal number **108** is translated into the binary number **1101100**

 **Hence,10810 = 11011002**

**Q5. Convert the following decimal numbers (base 10) into octal (base 8).**

**a.**$(22)\_{10}$ **b.**$(31)\_{10}$ **c.**$(99)\_{10}$ **d.**$(108)\_{10}$

**Answer**:

1. **Converting the decimal number 22 into octal:**

**First Step**: **Divide** the integer part **by** the base (**8**), and **keep the remainder** after each division.

**Stop** dividing when the integer part reaches zero.

**Cont’d; Answer to Q5.a:**

|  |  |  |  |
| --- | --- | --- | --- |
| Number/base | Integer Part | Remainder | Remark |
| **22**/8 | 2 | **6** | **22**=2\*8 + 6 |
| **2**/8 | 0 | **2** | **2**=0\*8 + 2 |

**Second Step**: **Concatenate** the **remaindersbottom-up**.

Thus the decimal number **22** is translated into the octal number **26**

 **Hence, 2210 = 268**

1. **Converting the decimal number 31 into octal:**

**First Step**: **Divide** the integer part **by** the base (**8**), and **keep the remainder** after each division.

**Stop** dividing when the integer part reaches zero.

|  |  |  |  |
| --- | --- | --- | --- |
| Number/base | Integer Part | Remainder | Remark |
| **31**/8 | 3 | **7** | **31**=3\*8 + 7 |
| **3**/8 | 0 | **3** | **3**=0\*8 + 3 |

**Second Step**: **Concatenate** the **remaindersbottom-up**.

Thus the decimal number **31** is translated into the octal number **37**

 **Hence, 3110 = 378**

1. **Converting the decimal number 99 into octal:**

**First Step**: **Divide** the integer part **by** the base (**8**), and **keep the remainder** after each division.

**Stop** dividing when the integer part reaches zero.

|  |  |  |  |
| --- | --- | --- | --- |
| Number/base | Integer Part | Remainder | Remark |
| **99**/8 | 12 | **3** | **99**=12\*8 + 3 |
| **12**/8 | 1 | **4** | **12**=1\*8 + 4 |
| **1**/8 | 0 | **1** | **1**=0\*8 +1 |

**Second Step**: **Concatenate** the **remaindersbottom-up**.

Thus the decimal number **99** is translated into the octal number **143**

 **Hence, 9910 = 1438**

1. **Converting the decimal number 108 into octal:**

**First Step**: **Divide** the integer part **by** the base (**8**), and **keep the remainder** after each division.

**Stop** dividing when the integer part reaches zero.

|  |  |  |  |
| --- | --- | --- | --- |
| Number/base | Integer Part | Remainder | Remark |
| **108**/8 | 13 | **4** | **108**=13\*8 +4 |
| **13**/8 | 1 | **5** | **13**=1\*8 + 5 |
| **1**/8 | 0 | **1** | **1** =0\*8 +1 |

**Second Step**: **Concatenate** the **remaindersbottom-up**.

Thus the decimal number **108** is translated into the octal number **154**

 **Hence, 10810 = 1548**

**Q6.Convert the following decimal numbers (base 10) into hex (base 16).**

**a.**$(22)\_{10}$ **b.**$(31)\_{10}$ **c.**$(99)\_{10}$ **d.**$(108)\_{10}$

**Answer**:

1. **Converting the decimal number 22 into hex:**

**First Step**: **Divide** the integer part **by** the base (**16**), and **keep the remainder** after each division.**Stop** dividing when the integer part reaches zero.

|  |  |  |  |
| --- | --- | --- | --- |
| Number/base | Integer Part | Remainder | Remark |
| **22**/16 | 1 | **6** | **22**=1\*16 + 6 |
| **1**/16 | 0 | **1** | **1**=0\*16 + 1 |

**Second Step**: **Concatenate** the **remaindersbottom-up**.

Thus the decimal number **22** is translated into the hex number **16 Hence, 2210 = 1616**

1. **Converting the decimal number 31 into hex:**

**First Step**: **Divide** the integer part **by** the base (**16**), and **keep the remainder** after each division. **Stop** dividing when the integer part reaches zero.

|  |  |  |  |
| --- | --- | --- | --- |
| Number/base | Integer Part | Remainder | Remark |
| **31**/16 | 1 | **F** | **31**=1\*16+ 15 |
| **1**/16 | 0 | **1** | **1**=0\*16 + 1 |

**Second Step**: **Concatenate** the **remaindersbottom-up**.

Thus the decimal number **31** is translated into the hex number **1F Hence, 3110 = 1F16**

1. **Converting the decimal number 99 into hex:**

**First Step**: **Divide** the integer part **by** the base (**16**), and **keep the remainder** after each division.

**Stop** dividing when the integer part reaches zero.

|  |  |  |  |
| --- | --- | --- | --- |
| Number/base | Integer Part | Remainder | Remark |
| **99**/16 | 6 | **3** | **99**=6\*16 + 3 |
| **6**/16 | 0 | **6** | **6**=0\*16 + 6 |

**Second Step**: **Concatenate** the **remaindersbottom-up**.

Thus the decimal number **99** is translated into the hex number **63 Hence, 9910 = 6316**

1. **Converting the decimal number 108 into hex:**

**First Step**: **Divide** the integer part **by** the base (**16**), and **keep the remainder** after each division.

**Stop** dividing when the integer part reaches zero.

|  |  |  |  |
| --- | --- | --- | --- |
| Number/base | Integer Part | Remainder | Remark |
| **108**/16 | 6 | **C** | **108**=6\*16+12 |
| **6**/16 | 0 | **6** | **6**=0\*16 + 6 |

**Second Step**: **Concatenate** the **remaindersbottom-up**.

Thus the decimal number **108** is translated into the hex number **6C Hence, 10810 = 6C16**

**Q7. Perform the following binary arithmetic operation:**

1. **ADD: 11100 + 11011**
2. **ADD: 11101 + 10101**
3. **Subtract: 11010 – 10101**
4. **Subtract: 11100 - 11111**

**Answer:**

1. **1 1 1 0 0**

 **1 1 0 1 1**

**-----------**

**1 1 0 1 1 1**

1. **1 1 1 0 1**

 **1 0 1 0 1**

 **----------**

 **1 1 0 0 1 0**

1. **1 1 0 1 0 - 1 0 1 0 1 ---------- 0 0 1 0 1**
2. Since 11100 is smaller than 11111, then the answer is a **negative** value, and subtraction is conducted as follows: **1 1 1 1 1 - 1 1 1 0 0 ---------**

**-ve 0 0 0 1 1**

**Check: 28-31= -3 (i.e. A negative value)**

**Q8. Perform the following binary arithmetic operation:**

1. **ADD: 11100.01 + 11011.001**
2. **ADD: 11101.11 + 10101.101**
3. **Subtract: 11010.01 – 10101.10**
4. **Subtract: 11100.111 – 11111.001**

**Answer:**

**a. 1 1 1 0 0. 0 1 0**

 **1 1 0 1 1. 0 0 1**

**-------------------**

**11 0 1 1 1 .0 1 1**

**b.** **1 1 1 0 1. 1 1**

 **1 0 1 0 1. 1 0 1**

 **-----------------**

1. **1 0 0 1 1. 0 1 1**

1. **1 1 0 1 0 . 0 1 - 1 0 1 0 1 . 1 0 ---- ----------- 0 0 1 0 0 . 1 1**
2. Since 11100.111 is smaller than 11111.001, then the answer is a **negative** value, and subtraction is conducted as follows: **1 1 1 1 1. 0 0 1 - 1 1 1 0 0. 1 1 1 ---- ------------**

**-ve 0 0 0 1 0. 0 1 0**

**Check: 28.875-31.125= -2.25**

**(i.e. A negative value)**