**Digital Logic Assignment I**

**Chapter 2: Number Systems**

1. Subtract 11101.111-10100.101 using 1's and 2's complement.
2. Subtract: 453.35-321.17 using both 9's and 10's complement.
3. Subtract: 1010.110 – 101.101 using both 2's and 1's complement.
4. Subtract: 675.6 – 456.4 using both 10's and 9's complement.
5. Using r’s and (r-1)’s complement, perform subtraction:

* 1010100 – 1000100
* 111001 – 11011.1
* 2321 – 8301
* 1011 – 10100
* 952 – 873
* 1010.1 – 10100. 11
* 135.4 - 48
* 7729 – 842.4

ALL THE ANSWERS AND PROCESS BY SANDESH KUMAR

1. To subtract 11101.11111101.111 and 10100.10110100.101 using **1's complement** and **2's complement**, we follow these steps:

**Step 1: Write the minuend and subtrahend**

Minuend: 11101.111

Minuend: } 11101.111

Subtrahend: 10100.

{Subtrahend: } 10100.101

**Step 2: Find the 1's complement of the subtrahend**

To get the 1's complement, invert all the bits of 10100.10110100.101:

10100.101→01011.01010100.101

01011.010

**Step 3: Add the minuend to the 1's complement of the subtrahend**

11101.111+01011.010=101001.00111101.111 + 01011.010 = 101001.001

**Step 4: Handle the carry**

In 1's complement, if there is a carry, add it back to the least significant bit (LSB):

Carry: 1⇒01001.001+1=01001.010

{Carry: } 01001.001 + 1 = 01001.010

So, the result in 1's complement is:

Result: 01001.010(Binary)=9.25

**NOTE : SAME ANSWER BUT BY USING 2’S CPMLEMENT**

**Step 1: Find the 2's complement of the subtrahend**

The 2's complement is obtained by adding 1 to the 1's complement:

1’s complement of 10100.101=01011.010

{1's complement of } 10100.101 = 01011.010

2’s complement: 01011.010+1=01011.011

2's complement: 01011.010 + 1 = 01011.011

**Step 2: Add the minuend to the 2's complement of the subtrahend**

11101.111+01011.011=101001.01011101.111 + 01011.011 = 101001.010

**Step 3: Discard the carry**

In 2's complement, any overflow or carry is discarded:

Final result: 01001.010

**Final Answer**

* **1's complement result:** 01001.01001001.010 (Binary) or 9.259.25 (Decimal)
* **2's complement result:** 01001.01001001.010 (Binary) or 9.259.25 (Decimal)

1. To subtract 453.35−321.17453.35 - 321.17 using **9's complement** and **10's complement**, follow the step-by-step process:

**Subtraction using 9's complement**

**Step 1: Find the 9's complement of the subtrahend**

To calculate the 9's complement of 321.17321.17, subtract each digit from 9:

9−3=6,9−2=7,9−1=8,9−1=8,9−7=29 - 3 = 6, \quad 9 - 2 = 7, \quad 9 - 1 = 8, \quad 9 - 1 = 8, \quad 9 - 7 = 2

The 9's complement of 321.17321.17 is:

678.82678.82

**Step 2: Add the minuend and the 9's complement of the subtrahend**

453.35+678.82=1132.17453.35 + 678.82 = 1132.17

**Step 3: Handle the carry**

In 9's complement subtraction, if there is a carry in the leftmost digit, add it to the LSB. Here, the carry is 11:

132.17+1=132.18132.17 + 1 = 132.18

The result of 453.35−321.17453.35 - 321.17 using 9's complement is:

132.18132.18

BY **Subtraction using 10's complement**

**Step 1: Find the 10's complement of the subtrahend**

The 10's complement is obtained by adding 1 to the 9's complement:

9’s complement of 321.17=678.82 {9's complement of } 321.17 = 678.82 10’s complement: 678.82+0.01=678.83 {10's complement: } 678.82 + 0.01 = 678.83

**Step 2: Add the minuend and the 10's complement of the subtrahend**

453.35+678.83=1132.18453.35 + 678.83 = 1132.18

**Step 3: Discard the carry**

In 10's complement subtraction, discard the leftmost carry. The result is:

132.18132.18

**Final Answer**

* **9's complement result:** 132.18132.18
* **10's complement result:** 132.18132.18

To subtract 1010.110−101.1011010.110 - 101.101 using **1's complement** and **2's complement**, follow the process:

Minuend: 1010.110

{Minuend: } 1010.110 Subtrahend: 0101.101

**1. Subtraction using 1's complement**

**Step 1: Find the 1's complement of the subtrahend**

Invert all the bits of 0101.1010101.101:

0101.101→1010.0100101.101

1010.010

**Step 2: Add the minuend and the 1's complement of the subtrahend**

1010.110+1010.010=10101.0001010.110 + 1010.010 = 10101.000

**Step 3: Handle the carry**

In 1's complement, if there is a carry, add it to the LSB:

Carry: 1⇒0101.000+1=0101.001

0101.000 + 1 = 0101.001

The result of 1010.110−101.1011010.110 - 101.101 using 1's complement is:

Result: 0101.001

**2.Subtraction using 2's complement**

**Step 1: Find the 2's complement of the subtrahend**

The 2's complement is obtained by adding 1 to the 1's complement of the subtrahend:

1’s complement of 0101.101=1010.010

{1's complement of } 0101.101 = 1010.010

2’s complement: 1010.010+1=1010.011

{2's complement: } 1010.010 + 1 = 1010.011

**Step 2: Add the minuend and the 2's complement of the subtrahend**

1010.110+1010.011=10101.0011010.110 + 1010.011 = 10101.001

**Step 3: Discard the carry**

In 2's complement, any carry is discarded:

Final result: 0101.01

**Final Answer**

* **1's complement result:** 0101.0010101.001 (Binary) or 5.1255.125 (Decimal)
* **2's complement result:** 0101.0010101.001 (Binary) or 5.1255.125 (Decimal)

To subtract 675.6−456.4675.6 - 456.4 using **10's complement** and **9's complement**, follow the detailed steps below:

**Subtraction using 9's complement**

**4NO ANSWER**

**Step 1: Find the 9's complement of the subtrahend**

To calculate the 9's complement of 456.4456.4, subtract each digit from 9:

9−4=5,9−5=4,9−6=3,9−4=59 - 4 = 5, \quad 9 - 5 = 4, \quad 9 - 6 = 3, \quad 9 - 4 = 5

The 9's complement of 456.4456.4 is:

543.5543.5

**Step 2: Add the minuend to the 9's complement of the subtrahend**

675.6+543.5=1219.1675.6 + 543.5 = 1219.1

**Step 3: Handle the carry**

In 9's complement subtraction, if there is a carry, add it to the LSB. Here, the carry is 11:

219.1+1=219.2219.1 + 1 = 219.2

The result of 675.6−456.4675.6 - 456.4 using 9's complement is:

219.2219.2

**2 Subtraction using 10's complement**

**Step 1: Find the 10's complement of the subtrahend**

The 10's complement is obtained by adding 1 to the 9's complement of 456.4456.4:

9’s complement of 456.4=543.5

9's complement of } 456.4 = 543.5

10’s complement: 543.5+0.1=543.6

{10's complement: } 543.5 + 0.1 = 543.6

**Step 2: Add the minuend to the 10's complement of the subtrahend**

675.6+543.6=1219.2675.6 + 543.6 = 1219.2

**Step 3: Discard the carry**

In 10's complement subtraction, discard the leftmost carry. The result is:

219.2219.2

**Final Answer**

* **9's complement result:** 219.2219.2
* **10's complement result:** 219.2219.2

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**1. Binary: 1010100−10001001010100 - 1000100**

**Using 1's complement (r−1r-1):**

1. Minuend: 10101001010100, Subtrahend: 10001001000100.
2. Find the 1's complement of 10001001000100:  
   1000100→01110111000100 \rightarrow 0111011.
3. Add 1010100+01110111010100 + 0111011:  
   1010100+0111011=100100111010100 + 0111011 = 10010011.
4. Handle carry: Add carry 11 to LSB:  
   0010011+1=00101000010011 + 1 = 0010100.

Result (1's complement): 00101000010100 = 100100 (decimal).

**Using 2's complement (rr):**

1. Find 2's complement of 10001001000100:  
   0111011+1=01111000111011 + 1 = 0111100.
2. Add 1010100+01111001010100 + 0111100:  
   1010100+0111100=100100001010100 + 0111100 = 10010000.

Result (2's complement): 00101000010100 = 100100 (decimal).

**2. Binary: 111001−11011.1111001 - 11011.1**

Align decimal places: 111001.0−011011.1111001.0 - 011011.1.

**Using 1's complement (r−1r-1):**

1. Find 1's complement of 011011.1011011.1:  
   011011.1→100100.0011011.1 \rightarrow 100100.0.
2. Add 111001.0+100100.0111001.0 + 100100.0:  
   111001.0+100100.0=10110101.0111001.0 + 100100.0 = 10110101.0.
3. Handle carry: Add 11 to LSB:  
   0110101.0+1=0110110.00110101.0 + 1 = 0110110.0.

Result (1's complement): 0110110.00110110.0 = 52.052.0 (decimal).

**Using 2's complement (rr):**

1. Find 2's complement of 011011.1011011.1:  
   100100.0+0.1=100100.1100100.0 + 0.1 = 100100.1.
2. Add 111001.0+100100.1111001.0 + 100100.1:  
   111001.0+100100.1=10110101.1111001.0 + 100100.1 = 10110101.1.

Result (2's complement): 0110110.00110110.0 = 52.052.0 (decimal).

**3. Decimal: 2321−83012321 - 8301**

**Using 9's complement (r−1r-1):**

1. Find the 9's complement of 83018301:  
   9999−8301=16989999 - 8301 = 1698.
2. Add 2321+1698=40192321 + 1698 = 4019.
3. No carry means the result is negative. Take the 9's complement of 40194019:  
   9999−4019=59819999 - 4019 = 5981.

Result (9's complement): −5981-5981.

**Using 10's complement (rr):**

1. Find the 10's complement of 83018301:  
   1698+1=16991698 + 1 = 1699.
2. Add 2321+1699=40202321 + 1699 = 4020.
3. No carry means the result is negative. Take the 10's complement of 40204020:  
   9999−4020+1=59809999 - 4020 + 1 = 5980.

Result (10's complement): −5980-5980.

**4. Binary: 1011−101001011 - 10100**

**Using 1's complement (r−1r-1):**

1. Find 1's complement of 1010010100:  
   10100→0101110100 \rightarrow 01011.
2. Add 1011+010111011 + 01011:  
   01011+01011=01111001011 + 01011 = 011110.
3. No carry means result is negative. Take the 1's complement of 011110011110:  
   100001100001.

Result (1's complement): −10001-10001.

**Using 2's complement (rr):**

1. Find 2's complement of 1010010100:  
   01011+1=0110001011 + 1 = 01100.
2. Add 1011+011001011 + 01100:  
   01011+01100=1011101011 + 01100 = 10111.

Result (2's complement): −10001-10001.

**5. Decimal: 952−873952 - 873**

**Using 9's complement (r−1r-1):**

1. Find the 9's complement of 873873:  
   999−873=126999 - 873 = 126.
2. Add 952+126=1078952 + 126 = 1078.
3. Handle carry: Subtract 10001000 (base):  
   1078−1000=781078 - 1000 = 78.

Result (9's complement): 7878.

**Using 10's complement (rr):**

1. Find the 10's complement of 873873:  
   126+1=127126 + 1 = 127.
2. Add 952+127=1079952 + 127 = 1079.
3. Handle carry: Subtract 10001000 (base):  
   1079−1000=791079 - 1000 = 79.

Result (10's complement): 7979.

**6. Binary: 1010.1−10100.111010.1 - 10100.11**

**Using 1's complement (r−1r-1):**

Align decimal places: 1010.1001010.100 and 10100.11010100.110.

1. Find 1's complement of 10100.11010100.110:  
   10100.110→01011.00110100.110 \rightarrow 01011.001.
2. Add 1010.100+01011.0011010.100 + 01011.001:  
   1010.100+01011.001=100001.1011010.100 + 01011.001 = 100001.101.
3. No carry means result is negative. Take the 1's complement:  
   011110.010011110.010.

Result (1's complement): −11110.010-11110.010.

**Using 2's complement (rr):**

1. Find 2's complement of 10100.11010100.110:  
   01011.001+0.001=01011.01001011.001 + 0.001 = 01011.010.
2. Add 1010.100+01011.0101010.100 + 01011.010:  
   1010.100+01011.010=100001.1101010.100 + 01011.010 = 100001.110.

Result (2's complement): −11110.010-11110.010.

**7. Decimal: 135.4−48135.4 - 48**

**Using 9's complement (r−1r-1):**

1. Find the 9's complement of 048.0048.0:  
   999.9−048.0=951.9999.9 - 048.0 = 951.9.
2. Add 135.4+951.9=1087.3135.4 + 951.9 = 1087.3.
3. Handle carry: Subtract 10001000:  
   1087.3−1000=87.31087.3 - 1000 = 87.3.

Result (9's complement): 87.387.3.

**Using 10's complement (rr):**

1. Find the 10's complement of 048.0048.0:  
   951.9+0.1=952.0951.9 + 0.1 = 952.0.
2. Add 135.4+952.0=1087.4135.4 + 952.0 = 1087.4.
3. Handle carry: Subtract 10001000:  
   1087.4−1000=87.41087.4 - 1000 = 87.4.

Result (10's complement): 87.487.4.

**8. Decimal: 7729−842.47729 - 842.4**

**Using 9's complement (r−1r-1):**

1. Find the 9's complement of 0842.40842.4:  
   9999.9−0842.4=9157.59999.9 - 0842.4 = 9157.5.
2. Add 7729.0+9157.5=16886.57729.0 + 9157.5 = 16886.5.
3. Handle carry: Subtract 1000010000:  
   16886.5−10000=6886.516886.5 - 10000 = 6886.5.

Result (9's complement): 6886.56886.5.

**Using 10's complement (rr):**

1. Find the 10's complement of 0842.40842.4:  
   9157.5+0.1=9157.69157.5 + 0.1 = 9157.6.
2. Add 7729.0+9157.6=16886.67729.0 + 9157.6 = 16886.6.
3. Handle carry: Subtract 1000010000:  
   16886.6−10000=6886.616886.6 - 10000 = 6886.6