Binary coded decimal (BCD) Lecture 9

* Binary coded decimal (BCD)

- write each & every digit in 4bit binary
  → 4bit = Nibble

$(362.41)_{10}$ →

0011 0110 0010 . 0100 0001 = BCD

$(4921.8)_{10} = (0100\ 1001\ 0010\ 0001.\ 1000)_{BCD}$

$(100100010001.1)_{BCD}$ → 989.8

before point RTL & after point LTR make cell of four and write decimal.

* BCD addition
→ If we get invalid BCD or carry generated then add decimal 6 to the result.

0 to 9 → valid bcd, 10 – 15 invalid bcd

Q1

```
  0010      ——— 2
  0110      ——— 6
  1000      valid - 8
```

Q2

```
  1000
  0111
  1111
  0110
 00010001
    1  5
```

Ans

Date
Page No.

Q3

```
    1000              10000
    1000     ==>       0110
   ------          -----------
Carry  10000       0001 0110
                     1    6   -> (16)10 Ans
```

Carry
↓
Auxiliary Carry → carry generated when add two Nibbles are added

Q

```
        8    6
      1000 0110          86
  7 ← 0111 1000  8       78
      1111 1110
      0110 0010
     1 0110 0100
     1  6    4  — (164)10
```

Q5 ① → carry

```
      0101 1000
      0100 1000
      10100000
      0110 0110
     10 000 0110
     1   0    6
```

Q6

```
        0101 1000
        0100 0111
valid ← 1001 1111 → invalid
             0110 → added 6
invalid ← 1010 0101
added 6 ← 0110
        10000 0101
        1  0   5  → (105)10 Ans
```

inv inv inv
(1011 1100 ·101) → ( )
BCD

```
      1011 1100 · 1010
      0110 0110 · 0110
     10010011 . 0000
     1 2   3     0
```

(123.0)10 Ans

(1111 11011·111) BCD to ( )10 ?

```
   0001 1111 1011 · 1110
        0110 0110 · 0110
   100110 0010 · 0100  → (262·4)10
    2  6    2  ·  4
```

✓The Good Paper

* Bcd Substraction
  - → 9's Compliment
  - → 10's Compliment

- using 10's Compliment

− 9 → menuend	1001
5 → Subtrahand	− 0101

9
+ 10
−5
14
−10
4

1001 → 9
+ 0101 → 5
1110 → 14] → invalid bcd
0110 → added 6
10100

1 → ingnor carry
0100 → 4 → Ans

3) Take 10's Compliment of Subtrahand and add it to menuend

Case 1 If final carry generated or invalid Bcd the add 6 to the result. ~~As~~ Ans is +ve & is given by after ignoring carry

Case 2 If we get valid bcd and carry not ~~genel~~ generated then ans is −ve and is in 10's Compliment

Using 9's compliment

```
  9         9                    1001
- 5       + 9 → extra      ]→ + 0100
          - 5                   1101  invalid
          ----                  0110
           13                  ------
          + 6 → extra          10011
          ----                  (end around carry)
           19
          -16                   0100  Ans
          + 1
          ----
            4
```

- Take 9's compliment of subtrahand and add it to menuend
- If final carry is generated or Invalid bcd then add 6 decimal to the result. Answer is +ve & is given by after "adding end around carry at last place"
- If we get valid bcd and carry not generated then ans is −ve and is 9's compliment

* Self Complimenting code

Base 10 ⇒ Excess-3 code is self Complementing

X−3 → BCD+3

(12 3. 4) → ( )$_{X-3}$

(0100 0101 0110 . 0111)$_{X-3}$ = BCD + 3

0 to 2 invalid x-3, 3 to 12 - valid x-3

14 to 16 → invalid x-3

0011 → 0
0100 - 1
0101 - 2
0110 - 3
0111 - 4
1000 - 5
1001 - 6
1010 - 7
1011 - 8
1100 - 9

1's compliment of the coded number gives the 9's compliment of the number itself

1's compliment

2 → 0101 → 1010 = 7
(0101 → x-3; 1010 → ~~9's compliment~~)

9's compliment of 2 = 7

1's compliment

* 3 → $(0110)_{x-3}$ → 1001 ←→ 9's compliment of 3 = 6

* 4 → $(0111)_{x-3}$ — 1000 → 5
9's compliment of 4