National University
of Computer and Emerging Sciences Chiniot-Faisalabad Campus

Instructor: Muhammad Adeel Tahir **EE1005 – Digital Logic Design**

Quiz# 1

Name:			**Section:**	CS - N	**Roll Number**				-				
Total Marks:	40 Marks	**Total Time:**	40 mins		**Marking (do not fill these)**								
Obtained Marks													

- Questions must be solved in the space provided for them, incase answers are not in the respective fields, they will not be marked
- Use extra rough sheets or spaces provided for your rough works, do not make a mess on the solution areas.
- MCQ questions must not have any cutting whatsoever, if more than one option is marked, it will be marked as incorrect.
- Only use permeant ink pen for marking your answers, answers written with pencils will not be checked.

Multiple Choice Questions: ***Circle the correct option*** or options (if more than one is correct) for the following questions. Once marked, any cutting will lead to 0 mark for the MCQ. **[10 marks]**

1. The given hexadecimal number $(1E.53)_{16}$ is equivalent to:
a) $(35.684)_8$ **b) $(36.246)_8$** c) $(34.340)_8$ d) $(35.599)_8$

2. The octal number $(651.124)_8$ is equivalent to ______
a) (1A9.2A)16 b) (1B0.10)16 c) (1A8.A3)16 d) (1B0.B0)16

3. Binary subtraction of 101101 – 001011 = ?
a) 100010 b) 010110 c) 110101 d) 101100

4. The binary number 10001101010001101111 can be written in hexadecimal as

(a) $AD467_{16}$ b) $8C46F_{16}$ **c) $8D46F_{16}$** (d) $AE46F_{16}$

5. On subtracting (010110)2 from (1011001)2 using 2's complement, we get ____________
a) 0111001 b) 1100101 c) 0110110 **d) 1000011**

6, On addition of +38 and -20 using 2's complement, we get ____________
a) 11110001 b) 100001110 **c) 010010** d) 110101011

7. An overflow occurs in _________
a) MSD position b) LSD position c) Middle position d) Signed Bit *(MSD|LSD , D refers to digit)*

8. The advantage of 2's complement system is that _________
a) Only one arithmetic operation is required b) Two arithmetic operations are required
c) No arithmetic operations are required d) Different Arithmetic operations are required

9. For arithmetic operations only _________
a) 1's complement is used **b) 2's complement** c) 10's complement d) 9's complement

10. The excess-3 code for 597 is given by __________
a) 100011001010 b) 100010100111 c) 010110010111 d) 010110101101

Answer Box (mark the correct letter i.e a,b,c,d in SEQUENCE)

b	a	a	c	d	c	a	a	b	a

For Rough Work Only

Question 1: Convert the decimal number **97.7_{10}** into a number with the same value represented in the following bases. The exact value requires an infinite repeating part in the fractional part of the number. Show the steps of your derivation.

(a) binary (b) octal (c) hexadecimal (d) base 3 (e) base 5 **[1+1+1+1+1+3 = 8 marks]**

Question 1: Convert the decimal number 97.710 into a number with exactly the same value rep□resented in the following bases. The exact value requires an infinite repeating part in the fractional part of the number. Show the steps of your derivation.

(a) binary (b) octal (c) hexadecimal (d) base 3 (e) base 5

Solution:

(a), (c) (b), (c)

16 | 97			.7
16 | 6	r1		16
0	r6		(11).2
			16
			(3).2

$\therefore 97.7_{10} = 61.B3333\ldots_{16}$

(a) $61.B3333\ldots_{16}$

$= 110\ 0001.1011\ 0011\ 0011\ 0011\ 0011\ldots_2$

(b) $1\ 100\ 001.101\ 100\ 110\ 011\ 001\ 100\ 11\ldots_2$

$= 141.5\ 4631\ 4631\ldots_8$

(d)

3 | 97		.7
3 | 32	r1	3
3 | 10	r2	(2).1
3 | 3	r1	3
3 | 1	r0	(0).3
0	r1	3
		(0).9
		3
		(2).7

$\therefore 97.7_{10} = 10121.2002\ldots_3$

(e)

5 | 97		.7
5 | 19	r2	5
5 | 3	r4	(3).5
0	r3	5
		(2).5

$\therefore 97.7_{10} = 342.322\ldots_5$

Question 2: Add the following numbers in binary using both 1's and then 2's complement to represent negative numbers. Use a word length of 6 bits (including sign) and indicate if an overflow occurs

Solution:

a)

In 2's complement
(–10) + (–11)
110110
110101
(1)101011 (–21)

In 1's complement
(–10) + (–11)
110101
110100
(1)101001
1
101010 (–21)

b)

In 2's complement
(–8) + (–11)
111000
110101
(1)101101 (–19)

In 1's complement
(–8) + (–11)
110111
110100
(1)101011
1
101100 (–19)

Convert $(64^{1/3})5$ to Hexadecimal. (if possible) **[3 marks]**

$[(4^3)^{1/3}]_5$

$= (4)_5 \rightarrow ?_{16}$

Base 5 to decimal calculation:

$(4)_5 = (4 \times 5^0) = (4)_{10}$

Decimal to base 16 calculation:

Divide by the base to get the digits from the remainders:

Division	Quotient	Remainder (Digit)	Digit #
4/16	0	4	0

$= (4)_{16}$

Question 3: One of the following bit patterns is valid BCD (binary-coded decimal), but the other one is not, Which one is not valid? For credit to be given, you must give a correct reason. **[2 marks]**
1. 100110110100
2. 100100111000

Which one is valid? **2nd one**
Why is the other one not valid:
In BCD, each 4-bit group (nibble) represents a decimal digit from 0 to 9. Each nibble must be between 0000 and 1001.
Breaking down the given bit pattern into nibbles:

1. **1001**
2. **1011**
3. **0100**

The second nibble, 1011, is not a valid BCD representation, as it exceeds the maximum value of 1001. Therefore, the entire bit pattern is invalid.

Question 4: Find the 9's and the 10's complement of the following decimal numbers: **[4 marks]**

	00,000,000
9s comp:	99,999,999
10s comp:	00,000,000

Step 1: Find the 9's Complement

We obtain the 9's complement of a decimal number by subtracting each digit from 9.

$$\begin{array}{r} 9999999 \\ -\,5274630 \\ \hline 4725369 \end{array}$$

Step 2: Add 1 to the 9's Complement

We add 1 to the 9's complement to obtain the 10's complement.

$$\begin{array}{r} 4725369 \\ +\quad\quad 1 \\ \hline 4725370 \end{array}$$

Question 5: Add the signed numbers: 01000100, 00011011, 00001110, and 00010010 and write your final answer in the provided space. **[2 marks]**

Solution

The equivalent decimal additions are given for reference.

Decimal	Binary	
68	01000100	
+ 27	+ 00011011	Add 1st two numbers
95	01011111	1st sum
+ 14	+ 00001110	Add 3rd number
109	01101101	2nd sum
+ 18	+ 00010010	Add 4th number
127	**01111111**	Final sum

Final Answer:	(In Binary): 01111111	(In Decimal): 127

Question 6: Add the following BCD numbers: **[2 + 2 = 4 marks]**

(c)

```
     0001    0110                                        16
   + 0001    0101                                      + 15
     0010    1011   Right group is invalid (>9),         31
                      left group is valid.
           + 0110   Add 6 to invalid code. Add
                      carry, 0001, to next group.
     0011    0001   Valid BCD number
       ↓       ↓
       3       1
```

(d)

```
            0110      0111                                  67
          + 0101      0011                                + 53
            1011      1010   Both groups are invalid (>9)   120
          + 0110    + 0110   Add 6 to both groups
   0001     0010      0000   Valid BCD number
     ↓        ↓         ↓
     1        2         0
```

Question 7 Gray code conversions. Attempt the following parts carefully. **[1+1+2 =4 marks]**

(a) Convert the binary number 11000110 to Gray code

Solution

(a) Binary to Gray code:

1 −+→ 1 −+→ 0 −+→ 0 −+→ 0 −+→ 1 −+→ 1 −+→ 0

↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓

1 0 1 0 0 1 0 1

(b) Convert the Gray code 10101111 to binary.

(b) Gray code to binary:

1 0 1 0 1 1 1 1

↓ + ↗ ↓ + ↗ ↓ + ↗ ↓ + ↗ ↓ + ↗ ↓ + ↗ ↓ + ↗ ↓

1 1 0 0 1 0 1 0

(c) The ten-bit Gray code for $(353)_{10}$ is 0111010001. Explain briefly but precisely why it cannot be true that 0111010100 is the ten-bit Gray code for $(354)_{10}$.

Also calculate gray code for 354_{10}

Gray Code for $(354)_{10}$:
111010011

Explanation:
In Gray code, consecutive numbers differ by only **one bit.**
Given that the Gray code for 353_{10} is 0111010001, the Gray code for 354_{10} must differ by **exactly one bit**.
If we compare 0111010100 to 0111010001, we see that **two bits** are different (positions 8 and 2). **This violates the fundamental property of Gray code. Therefore, 0111010100 cannot be the correct Gray code for 354_{10}.**

Question 8: Construct a 6-2-2-1 weighted code for decimal digits. What are all possible combinations through which the 9823_{10} can be constructed using the weight in 6-2-2-1? **[4 + 3 = 7 marks]**

	6 2 2 1	
0	0 0 0 0	
1	0 0 0 1	
2	0 0 1 0	(0100)
3	0 0 1 1	(0101)
4	0 1 1 0	
5	0 1 1 1	
6	1 0 0 0	
7	1 0 0 1	
8	1 0 1 0	(1100)
9	1 0 1 1	(1101)

1100 0011 = 83

Different Combinations to represent **9823_{10}**

Digit 9 in 6-2-2-1 weighted code: 1011
Digit 8 in 6-2-2-1 weighted code: 1010
Digit 2 in 6-2-2-1 weighted code: 0010
Digit 3 in 6-2-2-1 weighted code: 0011

there were other combinations as well one is written here for simplicity:
1101 (9) 1100 (8) 0100 (2) 0101 (3)
… and so on.

If 4 written correctly , full marks are awarded.

FOR ROUGH WORK ONLY (will not be checked):