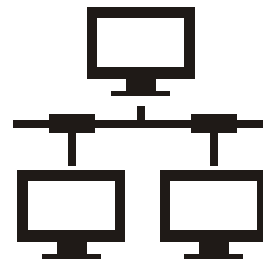# COMPUTER SCIENCE & IT

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COMPUTER SCIENCE & IT

Digital Logic

1
CHAPTER

Basics of Digital Logic

Q.1 $(10110011100011110000)_2$ in base 32 is
- (a) 2214716
- (b) 1192331
- (c) 11976
- (d) 11142316

Q.2 The hexadecimal representation of $(657)_8$ is
- (a) $(1AF)_H$
- (b) $(D78)_H$
- (c) $(D71)_H$
- (d) $(32F)_H$

Q.3 The binary equivalent of the decimal number 0.4375 is
- (a) 0.0111
- (b) 0.1011
- (c) 0.1100
- (d) 0.1010

Q.4 Zero has two representations in
- (a) Sign magnitude
- (b) 1's complement
- (c) 2's complement
- (d) Both (a) and (b)

Q.5 Which of the following code is a weighted code?
- (a) Gray
- (b) Excess-3
- (c) Shift counter
- (d) 5111

Q.6 In signal magnitude representation, the binary equivalent of 22.5625 is (the bit before comma represents the sign).
- (a) 0, 10110.1011
- (b) 0, 10110.1001
- (c) 1, 10101.1001
- (d) 1,10110.1001

Q.7 A variable takes thirteen possible values. It can be communicated using
- (a) Thirteen bits
- (b) Three bits
- (c) $\log_2^{13}$ bits
- (d) Four bits

Q.8 Convert $(-54)_{10}$ to hexadecimal.
- (a) $(34)_{16}$
- (b) $(CA)_{16}$
- (c) $(54)_{16}$
- (d) $(DA)_{16}$

Q.9 The 2's complement representation of $(539)_{10}$ in hexadecimal is
- (a) ABE
- (b) DBC
- (c) DE5
- (d) 21B

Q.10 What is 2's complement of $(101)_3$?
- (a) $(010)_3$
- (b) $(011)_3$
- (c) $(121)_3$
- (d) $(121)_2$

Q.11 Which of the following decimal numbers can be exactly represented in binary notation with a finite number of bits?
- (a) 0.1
- (b) 0.2
- (c) 0.4
- (d) 0.5

Q.12 A particular number system has 18 symbols from 0 to 9, A, B, C, E, S, G, T. If two numbers GATE and CSE are given to an adder, then output of adder is
- (a) TC7A
- (b) T5EA
- (c) G5SA
- (d) T5SA

Q.13 The square of octal number 23 is
- (a) 529
- (b) 539
- (c) 551
- (d) 650

Q.14 If $(123)_5 = (X3)_Y$, then the number of possible values of x is
- (a) 4
- (b) 3
- (c) 2
- (d) 1

Q.15 If $(2.3)_{base\ 4} + (1.2)_{base\ 4} = (y)_{base\ 4}$, what is the value of y?
- (a) 10.1
- (b) 10.01
- (c) 10.2
- (d) 1.02

Q.16 F's complement of $(2BFD)_{16}$ is
- (a) E304
- (b) D403
- (c) D402
- (d) C403

Q.17 Which of the following weighted code will give 9's complement by complementing each individual bit?
- (a) Excess-3
- (b) 5421
- (c) 2421
- (d) Both (a) and (c)

Q.18 Consider a system which has two eight bit inputs $D_1 = 01010101$, $D_2 = 00000000$, the system produces eight bit output that is bitwise XOR of the inputs. The eight bit output of system is input to the Gray Code Converter. The decimal equivalent of the output from Gray Code converter is _____.

Q.19 Which of the following statement is Incorrect for the range of n bit binary numbers?
(a) Range of unsigned numbers is 0 to $2^n - 1$.
(b) Range of signed number is $-2^{n-1} + 1$ to $2^{n-1} - 1$.
(c) Range of signed 1's complement numbers is $-2^{n-1} + 1$ to 2^{n-1}.
(d) Range of signed 2's complement numbers is -2^{n-1} to $2^{n-1} - 1$.

Q.20 The greatest negative number which can be stored in computer that has 8-bit word length and uses 2's complement arithmetic is
(a) -256
(b) -255
(c) -128
(d) -127

Q.21 Correct $(1101)_2$ is corresponding excess-3.
(a) 00010000
(b) 01000110
(c) 00100110
(d) 00010110

Q.22 Find the value of x in the given equation
$$(2)_3 + (3)_4 = (x)_5$$

Q.23 What are the value of R_1 and R_2 respectively in the expression $(235)_{R1} = (565)_{10} = (1065)_{R2}$
(a) 8, 16
(b) 16, 8
(c) 6, 16
(d) 12, 8

Q.24 Convert $(3121.121)_4$ to base 3?
(a) 10022.100
(b) 22001.100
(c) 22001.101
(d) 10022.110

Q.25 The number of 1's in the binary representation of $(3 * 4096 + 15 * 256 + 5 * 16 + 3)$ are
(a) 8
(b) 9
(c) 10
(d) 12

Q.26 Two numbers -48 and -23 are added using 2's complement. The 2's complement of the result using 8 bit representation is _____.
(a) 10111001
(b) 01000111
(c) 01101010
(d) 11100111

Q.27 A number in 4-bit two's complement representation is $X_3 X_2 X_1 X_0$. This number when stored using 8 bits will be
(a) $0\,0\,0\,0\,X_3\,X_2\,X_1\,X_0$
(b) $1\,1\,1\,1\,X_3\,X_2\,X_1\,X_0$
(c) $X_3\,X_3\,X_3\,X_3\,X_3\,X_2\,X_1\,X_0$
(d) $\bar{X_3}\bar{X_3}\bar{X_3}\bar{X_3}\bar{X_3}X_2 X_1 X_0$

Q.28 Result of the subtraction with the following unsigned decimal numbers by taking the 10's complement of the subtrahend. $1753 - 8640$
(a) 3113
(b) 10393
(c) -6887
(d) -3113

Q.29 Given that $(EOB)_H - (ABF)_H = Y$. The radix 8's complement of Y is
(a) 844
(b) 1514
(c) 6264
(d) 3251

Q.30 Let $A = 1111\ 1010$ and $B = 0000\ 1010$ be two 8 bit 2's complement numbers. Their product in 2's complement is
(a) 1100 0100
(b) 1001 1100
(c) 1010 0101
(d) 1101 0101

Q.31 If $(11x1y)_8 = (12C9)_{16}$ then the values of x and y are
(a) 3 and 1
(b) 5 and 7
(c) 7 and 5
(d) 1 and 5

Q.32 $(FE35)_{16}$ XOR $(CB15)_6$ is equal to
(a) $(3320)_{16}$
(b) $(FF35)_{16}$
(c) $(FF50)_{16}$
(d) $(3520)_{16}$

Q.33 Which of the following represents $(E3)_{16}$?
(a) $(1CE)_{16} + (A2)_{16}$
(b) $(1BC)_{16} - (DE)_{16}$
(c) $(2BC)_{16} - (1DE)_{16}$
(d) $(200)_{16} - (11D)_{16}$

Q.34 $(X)_8$ is expressed in Gray code as $(11110)_2$. The value of X is _____.

Q.35 Given $(135)_{\text{base } x} + (144)_{\text{base } x} = (323)_{\text{base } x}$. The value of base x is _____.

Q.36 The minimum decimal equivalent of the number 11C.0 is _____.

Q.37 The number of 1's in 8-bits representation of -127 in 2's complement form is m and that in 1's complement form is n. What is the value of m/n?

Q.38 If $(28)_x$ in base x number system is equal to $(37)_y$ in base y number system, the possible values of x and y are:
(a) 5, 3
(b) 8, 7
(c) 3, 4
(d) 13, 9

Answers	**Basics of Digital Logic**							

1. (a)	**2.** (a)	**3.** (a)	**4.** (d)	**5.** (d)	**6.** (b)	**7.** (d)	**8.** (b)	**9.** (d)
10. (c)	**11.** (d)	**12.** (d)	**13.** (c)	**14.** (c)	**15.** (a)	**16.** (c)	**17.** (c)	**18.** (127)
19. (c)	**20.** (c)	**21.** (b)	**22.** (10)	**23.** (b)	**24.** (c)	**25.** (c)	**26.** (b)	**27.** (c)
28. (c)	**29.** (c)	**30.** (a)	**31.** (a)	**32.** (d)	**33.** (d)	**34.** (24)	**35.** (6)	**36.** (194)
37. (2)	**38.** (d)	**39.** (c)	**40.** (a)	**41.** (a)	**42.** (33)	**43.** (d)	**44.** (a)	**45.** (a)
46. (d)	**47.** (1101)	**48.** (c)	**49.** (c)	**50.** (15)	**51.** (54)	**52.** (d)	**53.** (a, c)	**54.** (b, d)
55. (c, d)	**56.** (b, c)	**57.** (b, c)	**58.** (a, b)	**59.** (b, c)	**60.** (a, b, c)			

Explanations	**Basics of Digital Logic**

1. (a)

To convert to base 8, we group in 3's because $2^3 = 8$.

To convert to base 16, we group in 4's because $2^4 = 16$.

To convert to base 32, we group in 5's because $2^5 = 32$.

Grouping in 5's, from the right we get the answer.

So $\underbrace{10110}_{22}$ $\underbrace{01110}_{14}$ $\underbrace{00111}_{7}$ $\underbrace{10000}_{16}$

2. (a)

Octal number 657_8

Binary representation of 657_8

$\underbrace{0\ 0\ 0\ 1}\ \underbrace{1\ 0\ 1\ 0}\ \underbrace{1\ 1\ 1\ 1}$

Hexadecimal representation of $(657)_8$
$= (1\,AF)_H$

3. (a)

$(0.4375)_{10}$

(i)
$$\begin{array}{r} 0.4375 \\ \times 2 \\ \hline 0.8750 \\ \downarrow \\ 0 \end{array}$$

(ii)
$$\begin{array}{r} 0.8750 \\ \times 2 \\ \hline 1.7500 \\ \downarrow \\ 1 \end{array}$$

(iii)
$$\begin{array}{r} 0.75 \\ \times 2 \\ \hline 1.50 \\ \downarrow \\ 1 \end{array}$$

(iv)
$$\begin{array}{r} 0.50 \\ \times 2 \\ \hline 1.0 \\ \downarrow \\ 1 \end{array}$$

$\therefore (0.4375)_{10} = (0.0111)_2$

Hence, (a) is correct option

4. (d)

Zero has two representations in sign magnitude:
1. MSB is 0.
2. MSB is 1.

Both of these representations have equal value i.e., 0.

In 1's complement, 0 has two representations.
1. All bits are zero.
2. All bits are 1.

5. (d)

Weighted codes are the ones in which every bit position is assigned a weight.

∴ 5111 is a weighted code where the weight for MSB is 5 and for LSB is 1.

6. (b)

Sign bit must be 0 (+ve number)

$(22)_{10} = (10110)_2$
$(0.5625)_{10} = (0.1001)_2$
$0.5625 \times 2 = 1.125$
$0.125 \times 2 = 0.25$
$0.25 \times 2 = 0.5$
$0.5 \times 2 = 1.0$

∴ Correct answer is 0, 10110.1001.

7. (d)

As there are only 13 possible values, a variable can take, we need to use $\lceil \log_2^{13} \rceil$ bits = 4 bits.

8. (b)

$(54)_{10}$ in 8 bit binary is $(00110110)_2$

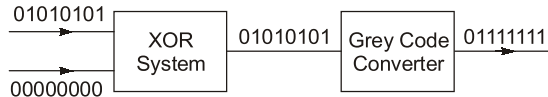$(-54)_{10}$ in 2's complement representation is $(11001010)_2$.

Now, grouping 4 digits each from LSB to MSB, we get $(CA)_{16}$.

9. (d)

$(539)_{10}$ in 2's complement representation is $(0010\ 0001\ 1011)_2$ which is equivalent to $(21B)_{16}$.

10. (c)

2's complement of $(101)_3 = 222 - 101 = (121)_3$
[∵ $(r-1)$'s complement]

11. (d)

0.5 is the only decimal number which has a terminating binary representation.

$$(0.5)_{10} = (0.1)_2$$
$$(0.1)_{10} = (0.00011....)_2$$
$$(0.2)_{10} = (0.00110....)_2$$
$$(0.4)_{10} = (0.01100....)_2$$

12. (d)

GATE + CSE
This is Base 18 number system
$$E + E = 14 + 14 = 28 = (1A)_{18}$$
$$T + S + carry = 17 + 15 + 1 = 33 = (1S)_{18}$$
$$A + C + carry = 10 + 12 + 1 - 23 = (15)_{18}$$
$$G + carry = 16 + 1 = (17) = T$$
∴ Answer is T5SA

13. (c)

$$(23)_8 = (19)_{10}$$
Square of $(19)_{10} = (361)_{10}$
∴ $(361)_{10} = (551)_8$

14. (c)

$$(123)_5 = (X3)_Y$$
As we can observe that
$$5^2 \times 1 + 2 \times 5^1 + 3 \times 5^0 = Y^2 \times X + 3XY^\circ$$
$$25 + 10 + \cancel{3} = YX + \cancel{3}$$
$$35 = YX$$
Since Y is the base, $Y > X$ and $Y > 3$
∴ Possible values are given by

$$X = \frac{35}{Y}$$

When $Y = 7$, $X = 5$ and $Y = 35$, $X = 1$
Hence (c) is the correct option.
Note that $(X = 7, Y = 5)$ and $(X = 35, Y = 1)$ are not possible.

15. (a)

```
   1
  2.3
 +1.2        3 + 2 = (5)_{10} = (11)_4
 10.1
```

16. (c)

$(2BFD)_{16}$

```
  FFFF
 -2BFD
  D402
```

17. (c)

Both Excess 3 codes and 2421 codes have this property and therefore, are called self complementary codes. But since the question requires weighted codes, the answer is '2421'.

18. (127)

```
01010101 ──→┌──────┐ 01010101 ┌───────────┐ 01111111
            │ XOR  │──────────│ Grey Code │──────────→
00000000 ──→│System│          │ Converter │
            └──────┘          └───────────┘
```

Decimal equivalent of 01111111 = 127.

19. (c)

Range of signed 1's complement numbers is $-2^{n-1} + 1$ to $2^{n-1} - 1$.

20. (c)

Range of integers that can be represented by a n bit two's complement representation is -2^{n-1} to $(2^{n-1} - 1)$.
Here, $n = 8$
∴ The greatest negative number which can be stored $= -2^7 = -128$.

21. (b)

Excess-3 is obtained when 3 is added to every digit of the BCD code.
$$(1101)_2 = (13)_{10}$$
$(13)_{10}$ in BCD is
To convert to excess 3.

```
  0001 0011
 +0011 0011
  0100 0110
```

22. (10)

$$(2)_3 = (2)_{10}$$
$$(3)_4 = (3)_{10}$$
$$(2)_{10} + (3)_{10} = (5)_{10} = (10)_5$$
∴ $x = 10$

23. (b)

$$(235)_{R_1} = \left(2R_1^2 + 3R_1 + 5\right)_{10} = (565)_{10}$$

Using the options, we can find out that R_1 must be 16.
$$(1065)_{R2} = ((R_2)^3 + 6R_2 + 5)_{10} = (565)_{10}$$
$$R_2 = 8 \text{ satisfies this equation.}$$
Note: $(235)_{R_1} = (565)_{10} = (1065)_{R_2}$