Logic Design – Tutorial 01

Numbering Systems

Q1	List the octal and hexadecimal numbers from 16 to 32. Using A, B. and C for the last three digits. list the numbers from 8 to 28 in base 13.
Sol 1	Base-10: 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 Octal: 20 21 22 23 24 25 26 27 30 31 32 33 34 35 36 37 40 Hex: 10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F 20 Base-13: 8 9 A B C 10 11 12 13 14 15 16 17 18 19 23 24 25 26

Q2	What is the exact number of bytes in a system that contains (a) 32K bytes. (b) 64M byres. and (c) 6.4G bytes?
Sol 2	(a) 32,768 (b) 67,108,864 (c) 6,871,947,674

Q3	Determine the base of the numbers in each case for the following operations to be correct: (a) 14/2 = 5, (b) 54/4 = 13, (c) 24 + 17 = 40.
Sol 3	Let b = base **(a)** 14/2 = (b + 4)/2 = 5, so b = 6 **(b)** 54/4 = (5*b + 4)/4 = b + 3, so 5 * b = 52 – 4, and b = 8 **(c)** (2 *b + 4) + (b + 7) = 4b, so b = 11

Q4	The solutions to the quadratic equation $x^2 - 11x + 22 = 0$ are $x = 3$ and $x = 6$. What is the base of the numbers?

Sol 4	$(x-3)(x-6) = x^2 - (6+3)x + 6*3 = x^2 - 11x + 22$ Therefore: $6 + 3 = b + 1$ so $b = 8$ Also, $6*3 = (18)_{10} = (22)_8$
Q5	Convert the decimal number 431 to binary in two ways: (a) Convert directly to binary; (b) convert first to hexadecimal and then from hexadecimal to binary. Which method is faster?
Sol 5	**(a)** Results of repeated division by 2 (quotients are followed by remainders): $431_{10} = 215(1);\quad 107(1);\quad 53(1);\ 26(1);\ 13(0);\ 6(1)\quad 3(0)\quad 1(1)$ Answer: $1111\_1010_2 = FA_{16}$ **(b)** Results of repeated division by 16: $431_{10} = 26(15);\quad 1(10)$ (Faster) Answer: FA = 1111_1010

Q6	Add and multiply the following numbers without converting them to decimal. (a) Binary numbers 1011 and 101. (b) Hexadecimal numbers 2E and 34.

Sol 6

(a) 10000 and 110111

$$\begin{array}{r} 1011 \\ +101 \\ \hline 10000 = 16_{10} \end{array} \qquad \begin{array}{r} 1011 \\ \times 101 \\ \hline 1011 \\ 1011 \\ \hline 110111 = 55_{10} \end{array}$$

(b) 62_h and 958_h

$$\begin{array}{rl} 2E_h & 0010\_1110 \\ +34_h & 0011\_0100 \\ \hline 62_h & 0110\_0010 = 98_{10} \end{array} \qquad \begin{array}{r} 2E_h \\ \times 34_h \\ \hline B^3 8 \\ 8^2 A \\ \hline 9\ 5\ 8_h = 2392_{10} \end{array}$$