EE2001-Tutorial 1
Date: 23rd January 2018
Binary Numbers, Boolean Algebra and Logic Gates

1(i) What is the exact number of bytes in a system that contains (a) 32K bytes, (b) 64M bytes, and (c) 6.4G bytes?
(ii) Convert the following numbers with the indicated bases to decimal:
(a) $(4310)_5$; (b) $(198)_{12}$; (c) $(435)_8$; (d) $(345)_6$.

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

3(i) Convert the hexadecimal number 64CD to binary, and then convert it from binary to octal.
(ii) Express the following numbers in decimal:
(a) $(10110.0101)_2$; (b) $(16.5)_{16}$; (c) $(26.24)_8$; (d) $(DADA.B)_{16}$;(e) $(1010.1101)_2$

4(i) Add and multiply the following numbers without converting them to decimal.
(a) Binary numbers 1011 and 101.
(b) Hexadecimal numbers 2E and 34.
(ii) Perform subtraction on the given unsigned binary numbers using the 2's complement of the subtrahend.
Where the result should be negative, find its 2's complement and affix a minus sign.
(a) 10011 - 10010 ; (b) 100010 - 100110 ; (c) 1001 - 110101 ; (d) 101000 - 10101

5) Convert decimal +49 and +29 to binary, using the signed-2's-complement representation and enough digits to accommodate the numbers. Then perform the binary equivalent of
(a) (+29) + (-49), (b) (-29) + (+49), and (c) (-29) + (-49).
Convert the answers back to decimal and verify that they are correct.

6) The state of a 12-bit register is 100010010111. What is its content if it represents
(a) Three decimal digits in BCD?
(b) Three decimal digits in the excess-3 code?
(c) Three decimal digits in the 84-2-1 code?
(d) A binary number?

7(i) Simplify the following Boolean expressions to a minimum number of literals:
(a) ABC + A'B + ABC' (b) x'yz + xz
(c) (x + y)'(x' + y') (d) xy + x(wz + wz')
(e) (BC' + A'D)(AB' + CD') (f) (a' + c') (a + b' + c')

(ii) Draw logic diagrams of the circuits that implement the original and simplified expressions of (i).

8(i) Find the complement of the following expressions:
(a) xy' + x'y ; (b) (a + c) (a + b') (a' + b + c') ; (c) z + z'(v'w + xy)
(ii) Implement the Boolean function F = xy + x'y' + y'z
(a) With AND, OR, and inverter gates
(b) With OR and inverter gates
(c) With NAND and inverter gates
(d) With NOR and inverter gates

9(i) Obtain the truth table of the following functions, and express each function in sum-of-minterms and product-of-maxterms form:
(a) (b + cd)(c + bd) ; (b) (cd + b'c + bd')(b + d)
(c) (c' + d)(b + c') ; (d) bd' + acd' + ab'c + a'c'
(ii) Express the complement of the following functions in sum-of-minterms form:
(a) F(A,B ,C, D) = Σ(2, 4, 7, 10, 12, 14)
(b) F(x, y, z) = Π(3, 5, 7)

10(i) Convert each of the following to the other canonical form:
(a) F(x, y, z) = Σ (1, 3, 5)
(b) F(A, B, C, D) = Π (3, 5, 8, 11)
(ii) Convert each of the following expressions into sum of products and product of sums:
(a) (u + xw)(x + u'v)
(b) x' + x(x + y')(y + z')