Digital Electronics

TUTORIAL SHEET NO. 2

1. Convert each of the following binary numbers to octal, decimal, and hexadecimal formats.

i. $(111011101.001)_2$ — Ans. $(735.1)_8 = (1DD.2)_{16} = (477.125)_{10}$
ii. $(10101010111)_2$ — Ans. $(2527)_8 = (11367)_{10} = (557)_{16}$
iii. $(111100000)_2$ — Ans. $(740)_8 = (480)_{10} = (1E0)_{16}$

2. Convert each of the following octal numbers to binary, decimal, and hexadecimal formats.

i. $(3754)_8$ — Ans. $(11111101100)_2 = (7EC)_{16} = (2028)_{10}$
ii. $(7777)_8$ — Ans. $(111111111111)_2 = (FFF)_{16} = (4095)_{10}$
iii. $(247.4)_8$ — Ans. $(10100111.100)_2 = (A7.8)_{16} = (167.5)_{10}$

3. Convert each of the following decimal numbers to binary, octal, and hexadecimal formats.

i. $(3479.25)_{10}$ — Ans. $(110110010111.01)_2 = (D97.4)_{16} = (6627.2)_8$
ii. $(642)_{10}$ — Ans. $(1010000010)_2 = (282)_{16} = (1202)_8$
iii. $(555)_{10}$ — Ans. $(1000101011)_2 = (22B)_{16} = (1053)_8$

4. Convert each of the following hexadecimal numbers to binary, octal, and decimal formats.

i. $(4FB2)_{16}$ — Ans. $(100111110110010)_2 = (47662)_8 = (20402)_{10}$
ii. $(88BAE)_{16}$ — Ans. $(10001000101110101110)_2 = (2105656)_8 = (560046)_{10}$
iii. $(DC4.7)_{16}$ — Ans. $(110111000100.0111)_2 = (6704.34)_8 = (3524.4375)_{10}$

5. Perform each of the addition operations indicated below.

i. $(1001011)_2 + (11101)_2$ — Ans. $(1101000)_2$
ii. $(4556)_8 + (1245)_8$ — Ans. $(6023)_8$
iii. $(BCD)_{16} + (A34)_{16}$ — Ans. $(1601)_{16}$

6. Form the two's complement of each of the following binary numbers.

i. (111011101110)2 — Ans. 000100010010
ii. (11111111000100)2 — Ans.00000000111100
iii. (100000000)2 — Ans. 100000000
iv. (1010101010111)2 — Ans. 0101010101001

7. Perform each of the subtraction using two's complement.

i. $(100101)_2 - (11011)_2$ — Ans. $(001010)_2$
ii. $(1101011)_2 - (111010)_2$ — Ans. $(0110001)_2$
iii. $(1110111)_2 - (10110111)_2$ — Ans. $(1000000)_2$

8. Simplify the following:

i. XY+XYZ+XYZ′+X′YZ=Y(X+Z)
ii. A′B′C′+A′BC′+A′BC=A′(C′+B)
iii. A′BC′D+A′BCD+ABD=BD
iv. A+A′B+AB′=A+B
v. AB+(AC)′+AB′C(AB+C)=1
vi. AB+AB′A+AB′C=[illegible]
vii. AB′C′+AB′C′D+AC′=AC′
viii. (A+B)(AC+C)(B+AC)′=A′B
ix. AB+AC+ABC(AB+C)=1
x. C(B+C)(A+B+C)=C
xi. (A+B)(A+B′)(A′+B)=AB
xii. A+AB+AB′C=A

9. Realize XOR and XNOR gate using

i. NAND gate only
ii. NOR gate only

10. Find the complement

i. Y=AB′C+A′B′C′
ii. Y=A(BC+B′C′)

11. Design a logic circuit using basic gates only, using NAND gates only and using NOR gates only

i. Y=(A+B+C′D)+A′BC′
ii. Y=ABC+B′C+CD
iii. Y=(A+B)(A+C′+D)+(B′+C)

12. Convert the following into canonical form and write their minterms and maxterms

i. AB+BC
ii. AB+ABC+BCD
iii. (A+B)(B+C)
iv. (A+C′+D)(A+B)(C′+D)

13. Develop the truth table of the following function

i. F=AB+AB'+B'C
ii. AB+BC'D+A'D

Tutorial Sheet-3

Q.1 Simplify the following expression using K-map and implement the simplified expression using basic gates

a) F(A,B,C,D)=$\sum m(1,3,5,7,8,9,12,13)$ $AC + \bar{A}D$
b) F(A,B,C,D)= $\sum m(8,10,11,12,13,14,15)$ $\bar{D}A + AB + AC$
c) F(A,B,C,D) = $\sum m(0,1,2,5,13,15)$ $ABD + \bar{A}\bar{C}D + \bar{A}\bar{B}\bar{D}$
d) F(A,B,C,D) = $\sum m(0,1,2,3,5,7,8,9,10,11,12,13)$ $\bar{B} + \bar{A}D + A\bar{C}$
e) F(A,B,C,D) = $\sum m(7,9,10,11,12,13,14,15)$ $AB + AC + AD + BCD$
f) F(A,B,C,D)=$AB + B\bar{C}D + \bar{A}D$ $AB + \bar{A}D$
g) F(A,B,C,D)=$\sum m(3,4,5,7,9,13,14,15)$ $\bar{A}CD + ABC + A\bar{C}D + \bar{A}B\bar{C}$
h) F(A,B,C,D)=$\Pi M(0,1,4,5,6,8,9,12,13,14)$ $(\bar{B} + D).C$
i) F(A,B,C,D)=$\Pi M(0,1,2,5,8,9,10)$ $(B + C).(\bar{A} + B + D).(A + C + \bar{D})$
j) F(A,B,C,D)=$\Pi M(0,1,3,6,7,8,9,11,13,14,15)$ $(\bar{A} + \bar{D}).(\bar{B} + \bar{C}).(B + C).(\bar{C} + \bar{D})$
k) F(A,B,C,D)=$\Pi M(0,1,2,3,5,6,7,8,10)$ $(B + D).(A + \bar{D}).(A + \bar{C})$
l) F(A,B,C,D)=$(A + \bar{B}).(\bar{C} + \bar{D}).(A + \bar{C}).(A + D).(B + D)$ ans . $(A + \bar{B}).(\bar{C} + \bar{D}).(B + D)$

Q.2 Simplify the following expression using K-map and implement the simplified expression using (i) only NAND gate (ii) only NOR gate

a) F(A,B,C,D) = $\sum m(1,3,4,6,8,911,13,15) + \sum d(0,2,14)$ $\bar{A}\bar{B} + \bar{A}\bar{D} + AD + \bar{B}\bar{C}$
b) F(W,X,Y,Z) = $\sum m(0,1,2,9,11,15) + \sum d(8,10,14)$ $\bar{X}\bar{Z} + \bar{X}\bar{Y} + WY$
c) F(A,B,C,D) = $\sum m(0,1,3,5,7,9,10,14,15) + \sum d(2,4)$ $\bar{A}\bar{B} + \bar{A}D + \bar{B}\bar{C}D + ABC + AC\bar{D}$
d) F(A,B,C,D) = $\sum m(0,1,3,4,9,11,14) + \sum d(5,12,15)$ $ABC + \bar{A}\bar{C} + \bar{B}D$
e) F(A,B,C,D) = $\sum m(0,2,3,5,7,12,15) + \sum d(1,4,8,11)$ $\bar{A}\bar{B} + CD + \bar{C}\bar{D} + \bar{A}D$
g) F(A,B,C,D) = $\Pi M(1,2,5,7,9,15).d(0,3,4,6)$ $A.(\bar{B} + \bar{C} + \bar{D}).(B + C + \bar{D})$
h) F(A,B,C,D) = $\Pi M(1,4,9,10,12,13,14).d(5,8,11,15)$ $\bar{A}.(\bar{B} + C).(C + \bar{D})$
i) F(A,B,C,D) = $\Pi M(0,1,3,4,9,11,14).d(5,12,15)$ $(A + C).(B + \bar{D}).(\bar{A} + \bar{B} + \bar{C})$
j) F(A,B,C,D) = $\Pi M(0,4,6,9,10,12,13,14).d(1,2,8)$ $D.(\bar{A} + C)$ k)
k)F(A,B,C,D) = $\Pi M(3,4,8,9,11,13,15).d(1,2,5,6)$ $(\bar{A} + B + C)(\bar{A} + \bar{D})(B + \bar{D})(A + \bar{B} + C)$

Q.3 Simplify the expression in POS using K-map

$$F(A,B,C,D) = \sum m(1,3,5,7) + \sum d(6,8,9,14,15)$$

and implement the simplified expression using

(i) only NAND gate (ii) only NOR gate (iii) Basic gates

Ans. $B.D$

Q.4 Simplify the expression in SOP using K-map

$$F(A,B,C,D) = \Pi M(0,2,3,6,8,11).d(7,9,12)$$

and implement the simplified expression using

(i) only NAND gate (ii) only NOR gate (iii) Basic gates

Ans. $B\bar{C} + \bar{C}D + AB$