

EE 2000 Logic Circuit Design
Semester A 2014

Tutorial 5

1. Design a combinational circuit for a 3-bit Binary-to-Gray code converter.

Ans:

Truth table

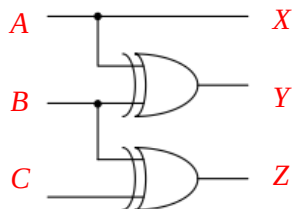
Input			Output		
A	B	C	X	Y	Z
0	0	0	0	0	0
0	0	1	0	0	1
0	1	0	0	1	1
0	1	1	0	1	0
1	0	0	1	1	0
1	0	1	1	1	1
1	1	0	1	0	1
1	1	1	1	0	0

$X = A$ (by visual inspection of the truth table)

$$\begin{aligned} Y &= A'BC' + A'BC + AB'C' + AB'C \\ &= A'B(C' + C) + AB'(C' + C) \\ &= A'B + AB' \\ &= A \oplus B \end{aligned}$$

$$\begin{aligned} Z &= A'B'C + A'BC' + AB'C + ABC' \\ &= B'C(A' + A) + BC'(A' + A) \\ &= B'C + BC' \\ &= B \oplus C \end{aligned}$$

Circuit:



2. (i) Complete the truth table of the following circuit given in Fig. 2(a).
(ii) Write down the logic expression of the following circuit and simplify as much as possible.
(iii) Draw the simplified logic expression obtained in (ii) using 2-input NAND gate(s) only.

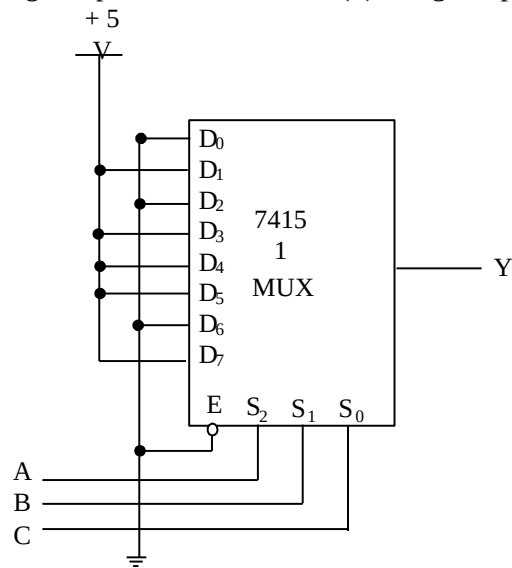


Fig. 2(a)

Ans:

A	B	C	Y
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

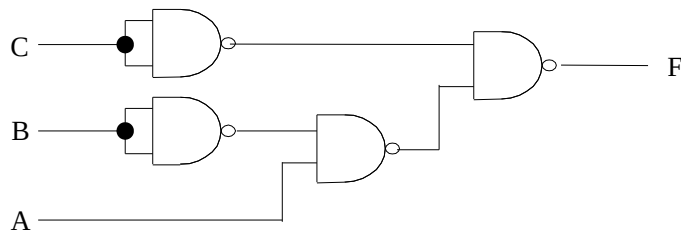
(i)

(ii)
$$Y = A'B'C + A'B'BC + A'B'C' + A'B'C + ABC$$

$$= B'C + BC + AB'$$

$$= C + AB'$$

(iii)
$$Y = C + AB' = [C'(AB')']'$$



3. There are four judges for a debate of two persons – A and B. Each judge has an ON/OFF button, which is used to record his/her opinion of which one wins his/her vote. The scoreboard shows an **A** when the majority vote is in favour of person A and a **B** if it is person B. Provision is also made for a **TIE**.

- Derive the Truth Tables separately for **A**, **B**, and **TIE**.
- Extract standard SOP and POS for each of the three outputs.
- Simplify the three logic expressions in SOP form.

Ans:

Assuming that: 0 means voting for B, and 1 means voting for A.

HIT means A wins, and MISS means B wins.

(i)

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>HIT</i>	<i>MISS</i>	<i>TIE</i>
0	0	0	0	0	1	0
0	0	0	1	0	1	0
0	0	1	0	0	1	0
0	0	1	1	0	0	1
0	1	0	0	0	1	0
0	1	0	1	0	0	1
0	1	1	0	0	0	1
0	1	1	1	1	0	0
1	0	0	0	0	1	0
1	0	0	1	0	0	1
1	0	1	0	0	0	1
1	0	1	1	1	0	0
1	1	0	0	0	0	1
1	1	0	1	1	0	0
1	1	1	0	1	0	0
1	1	1	1	1	0	0

- $HIT(a, b, c, d) = \Sigma m(7, 11, 13, 14, 15) = IIM(0, 1, 2, 3, 4, 5, 6, 8, 9, 10, 12)$
 $MISS(a, b, c, d) = \Sigma m(0, 1, 2, 4, 8) = IIM(3, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15)$
 $TIE(a, b, c, d) = \Sigma m(3, 5, 6, 9, 10, 12) = IIM(0, 1, 2, 4, 7, 8, 11, 13, 14, 15)$

(iii)

