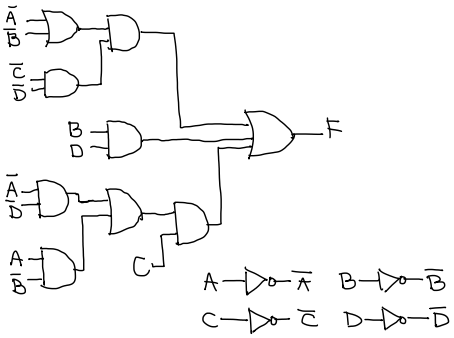
Question 1 F

Saturday, 7 March 2020 6:20 pm

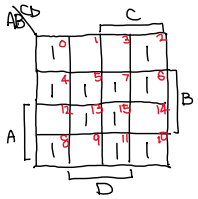
a) i)

Literals = 11
Terms = 8 ← $\bar{C}\bar{D}(\bar{A}+\bar{B})+BD+C(\bar{A}\bar{D}+A\bar{B})$
Complements = 4
GIC = 23

Students may draw logic diagram to determine GIC



ii) Students can use the K-map to find the minterms for F or use algebraic expansion



OR

$F = \bar{C}\bar{D}(\bar{A}+\bar{B}) + BD + C(\bar{A}\bar{D}+A\bar{B})$

$= \bar{A}\bar{C}\bar{D} + \bar{B}\bar{C}\bar{D} + BD + \bar{A}C\bar{D} + A\bar{B}C$

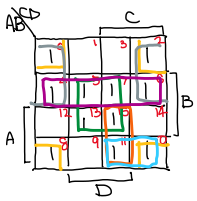
$= \bar{A}\bar{C}\bar{D}(B+\bar{B}) + \bar{B}\bar{C}\bar{D}(\bar{A}+A) + BD(\bar{A}+A)(C+\bar{C}) + \bar{A}C\bar{D}(B+\bar{B}) + A\bar{B}C(D+\bar{D})$

$F = \Sigma m(0, 2, 4, 5, 6, 7, 8, 10, 11, 13, 15)$

iii)

A	B	C	D	F	m_i
0	0	0	0	1	m_0
0	0	0	1	0	m_1
0	0	1	0	1	m_2
0	0	1	1	0	m_3
0	1	0	0	1	m_4
0	1	0	1	1	m_5
0	1	1	0	1	m_6
0	1	1	1	1	m_7
1	0	0	0	1	m_8
1	0	0	1	0	m_9
1	0	1	0	1	m_{10}
1	0	1	1	1	m_{11}
1	1	0	0	0	m_{12}
1	1	0	1	1	m_{13}
1	1	1	0	0	m_{14}
1	1	1	1	1	m_{15}

iv)



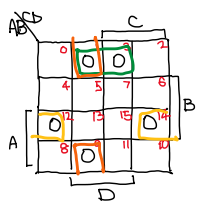
$F = \bar{B}\bar{D} + BD + \bar{A}\bar{D} + ACD$
or $F = \bar{B}\bar{D} + BD + \bar{A}\bar{D} + A\bar{B}C$
or $F = \bar{B}\bar{D} + BD + \bar{A}B + ACD$
or $F = \bar{B}\bar{D} + BD + \bar{A}B + A\bar{B}C$

SOP — any one is correct.

PI : $\bar{B}\bar{D}$, BD, $\bar{A}\bar{D}$, ACD, $A\bar{B}C$, $\bar{A}B$

EPI : $\bar{B}\bar{D}$, BD

V)



$F = (\bar{A}+\bar{B}+D)(B+C+\bar{D})(A+B+\bar{D})$ ← POS

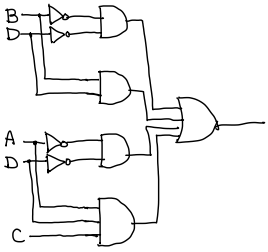
PI: $\bar{A}+\bar{B}+D$, $B+C+\bar{D}$, $A+B+\bar{D}$

EPI: $\bar{A}+\bar{B}+D$, $B+C+\bar{D}$, $A+B+\bar{D}$

vi) literals = 9
terms = 4
complements = 3
GIC = 16

Reduction of 7 GIC after optimisation

vii) $F = \bar{B}\bar{D} + BD + \bar{A}\bar{D} + ACD$



b)

binary	hexadecimal	octal
11101010.111	EA.E	352.7

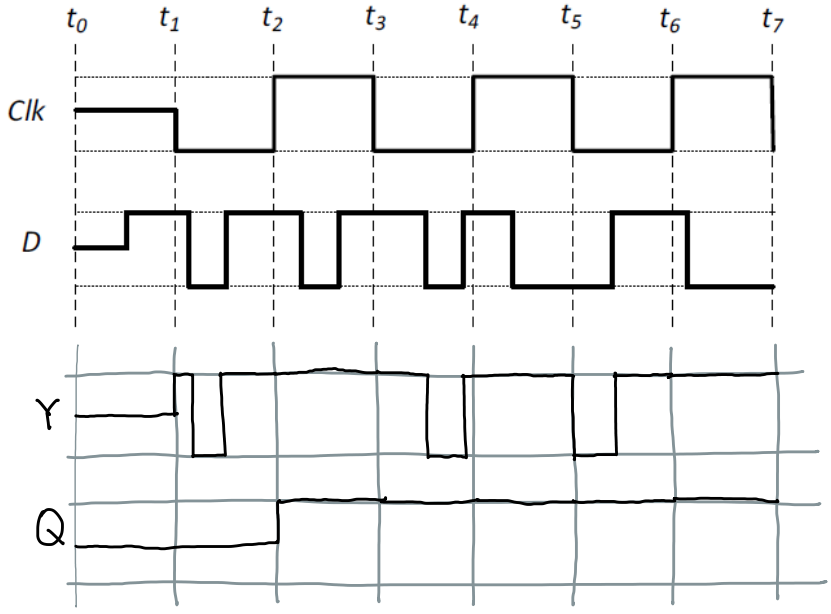
Hex → binary

11101010.1110
E A . E ← Hex

Binary → octal

011101010.111
3 5 2 . 7 ← octal

c) A – D latch
B – Positive edge triggered D flipflop



Question 2 F

Saturday, 7 March 2020 8:31 pm

a) i) $X+Y = X\oplus Y + XY$

$X\oplus Y + XY = X\bar{Y} + \bar{X}Y + XY$

$= X\bar{Y} + XY + XY + \bar{X}Y$

$= X(\bar{Y}+Y) + Y(X+\bar{X})$

$= X+Y$

ii) $H(A,B,C) = A\bar{B} + AB\bar{C} + \bar{A}B$

$= A\oplus B + AB\bar{C}$ ($X = A\oplus B$, $Y = AB\bar{C}$)

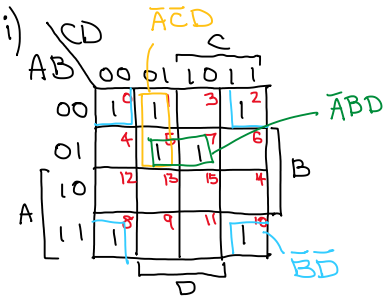
$= A\oplus B\oplus AB\bar{C} + (A\oplus B)(AB\bar{C})$

$= A\oplus B\oplus AB\bar{C} + (A\bar{B}+\bar{A}B)(AB\bar{C})$

$= A\oplus B\oplus AB\bar{C}$

$X+Y = X\oplus Y+XY$

b) i)



$G = \Pi M(3,4,6,9,11,12,13,14,15)$

$\Sigma m(0,1,2,5,7,8,10)$

$= \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}CD + \bar{A}BCD + A\bar{B}\bar{C}\bar{D} + A\bar{B}C\bar{D}$

$+\bar{A}BC\bar{D}$

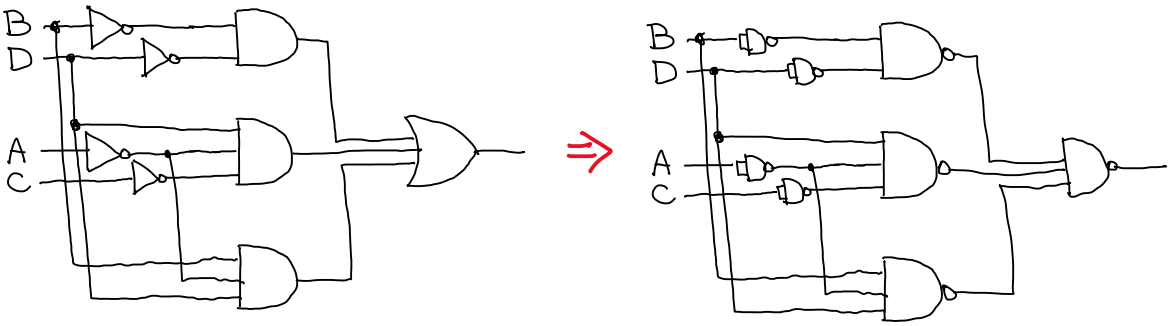
$= \bar{A}\bar{B}\bar{D}(\bar{C}+C) + \bar{A}\bar{C}D(\bar{B}+B) + \bar{A}BD(\bar{C}+C) + A\bar{B}\bar{D}(\bar{C}+C)$

$= \bar{A}\bar{B}\bar{D} + \bar{A}\bar{C}D + \bar{A}BD + A\bar{B}\bar{D}$

$= \bar{B}\bar{D}(\bar{A}+A) + \bar{A}\bar{C}D + \bar{A}BD$

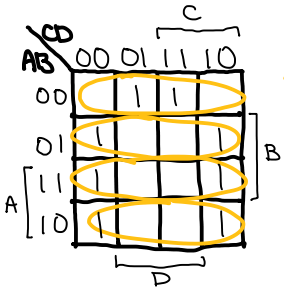
$= \bar{B}\bar{D} + \bar{A}\bar{C}D + \bar{A}BD$

ii) $G = \bar{B}\bar{D} + \bar{A}\bar{C}D + \bar{A}BD$



c) i)

A	B	C	D	Z	
0	0	0	0	0	
0	0	0	1	1	$Z = D$
0	0	1	0	0	
0	0	1	1	1	
0	1	0	0	1	
0	1	0	1	0	$Z = \overline{D}$
0	1	1	0	1	
0	1	1	1	0	
1	0	0	0	1	
1	0	0	1	0	$Z = \overline{D}$
1	0	1	0	1	
1	0	1	1	0	
1	1	0	0	1	
1	1	0	1	0	$Z = \overline{D}$
1	1	1	0	1	
1	1	1	1	0	



AB select

$I_0 = D$
$I_1 = \overline{D}$
$I_3 = \overline{D}$
$I_2 = \overline{D}$

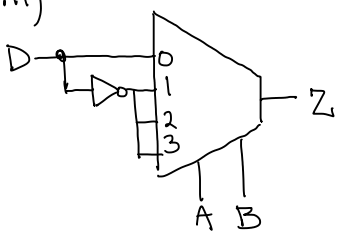
CD select

$I_0 = A + B$
$I_1 = \overline{A}\,\overline{B}$
$I_2 = A + B$
$I_3 = \overline{A}\,\overline{B}$

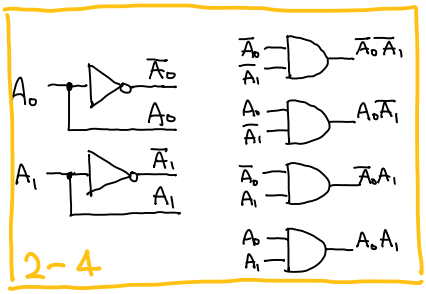
Note: Using CD as select would not give the simplest design.

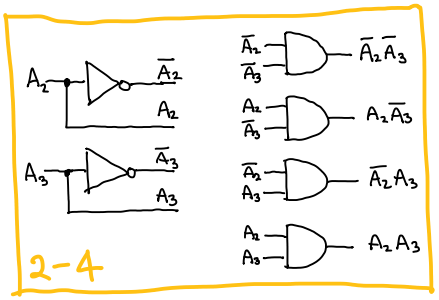
ii) $Z = \sum m(1,3,4,6,8,10,12,14)$

iii)

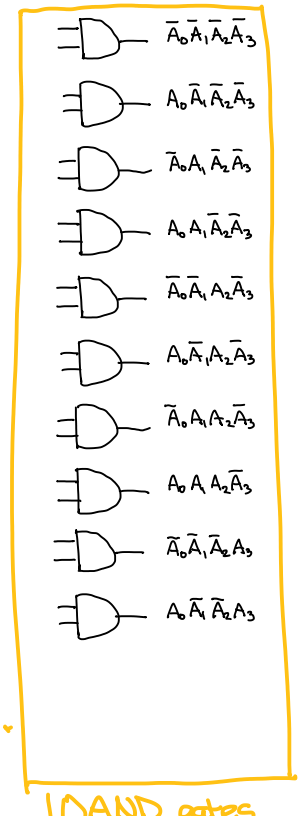


d) Not required!



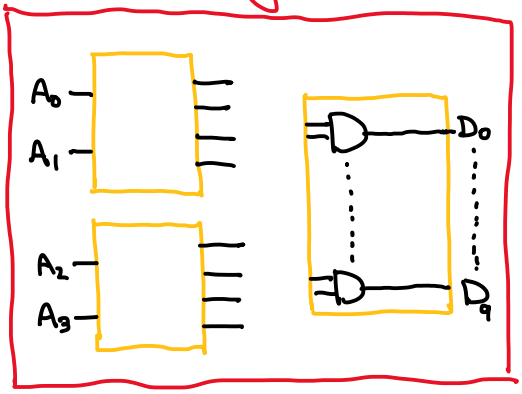


GIC = 4 + 4x2 + 4x2 + 10x2 = 40



10 AND gates

Block diagram



Refer to Week3 slide51

- Input n is even, n = 4.
  Use 2^n AND gates driven by two decoders of output size $2^{n/2} = 4$
  Since BCD is only from 0 to X, 16 - X - 1 AND gates will be redundant.