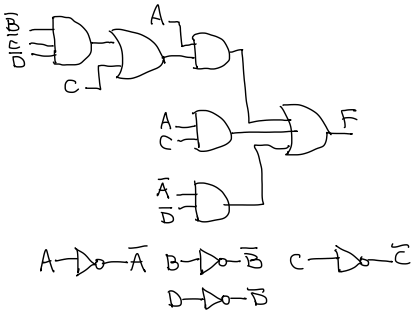
Question 1 B

Saturday, 7 March 2020 6:20 pm

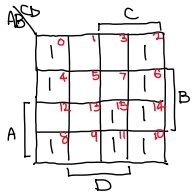
a) i) Literals = 9
Terms = 5
Complements = 4
GIC = 18

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

Students may draw logic diagram to determine the GIC.



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



OR

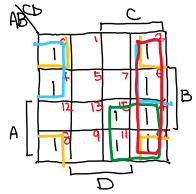
$F = A(\bar{B}\bar{C}\bar{D}+C)+AC+\bar{A}\bar{D}$
$= A\bar{B}\bar{C}\bar{D}+AC+AC+\bar{A}\bar{D}$
$= A\bar{B}\bar{C}\bar{D}+AC(B+\bar{B})(D+\bar{D})+\bar{A}\bar{D}(B+\bar{B})(C+\bar{C})$

$F=\Sigma m(0,2,4,6,8,10,11,14,15)$

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	0	m_5
0	1	1	0	1	m_6
0	1	1	1	0	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	0	m_{13}
1	1	1	0	1	m_{14}
1	1	1	1	1	m_{15}

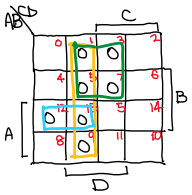
iv)



$F = \bar{B}\bar{D}+\bar{A}\bar{D}+AC$ ← SOP

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

v)



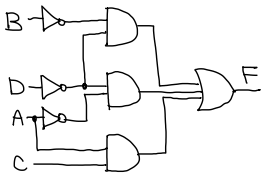
$F = (\bar{A}+\bar{B}+C)(C+\bar{D})(A+\bar{D})$ ← POS

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

vi) literals = 6
terms = 3
complements = 3
GIC = 12

Reduction of 6 GIC after optimisation

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



b)

binary	hexadecimal	octal
110101100.111	1AC.E	654.7

Hex → binary

0001 1010 1100 . 1110

10 12 14

A C E

$(1AC.E)_{16}$ ← Hex

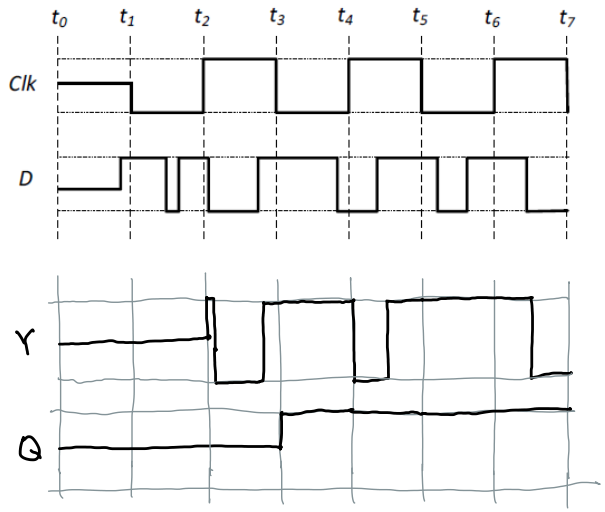
Binary → Octal

6 5 4 . 7

$(110101100.111)_2$ ← Binary

c) A - D latch

B - Positive edge triggered D-flipflop



Question 2 B

Saturday, 7 March 2020 8:31 pm

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

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

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

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

$= X+Y$

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

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

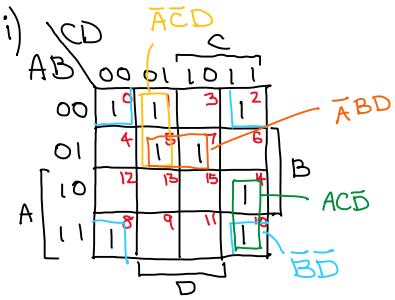
$= A \oplus B + AB\bar{C}$

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

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

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

b) i)



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

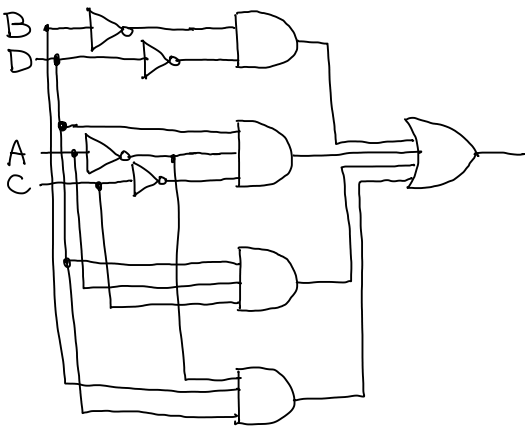
$= \Sigma m(0,1,2,5,7,8,10,14)$

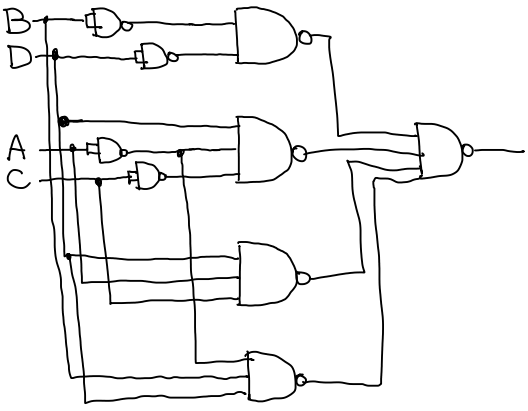
$= \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}BC\bar{D} + \bar{A}BCD + A\bar{B}\bar{C}\bar{D} + A\bar{B}C\bar{D} + ABC\bar{D}$
$+ A\bar{B}CD + \bar{A}B\bar{C}D$

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

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

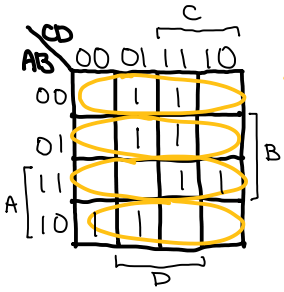
ii) $G = \bar{B}\bar{D} + \bar{A}\bar{C}D + AC\bar{D} + \bar{A}BD$





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	0	
0	1	0	1	1	$Z = D$
0	1	1	0	0	
0	1	1	1	1	
1	0	0	0	1	
1	0	0	1	1	
1	0	1	0	0	$Z = \bar{C}$
1	0	1	1	0	
1	1	0	0	0	
1	1	0	1	0	
1	1	1	0	1	$Z = C$
1	1	1	1	1	



AB select

$I_0 = D$
$I_1 = D$
$I_3 = C$
$I_2 = \bar{C}$

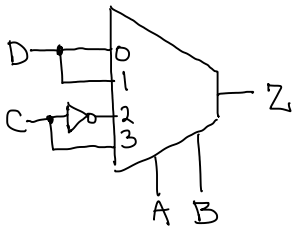
CD select

$I_0 = A\bar{B}$
$I_1 = \bar{A} + \bar{B}$
$I_2 = AB$
$I_3 = \bar{A} + B$

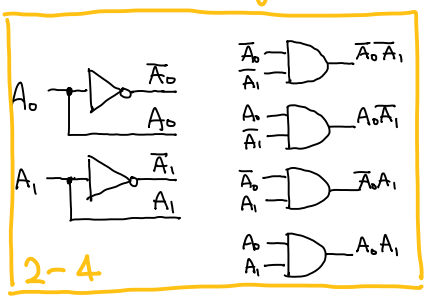
Note: Using CD as select would not give the simplest design.

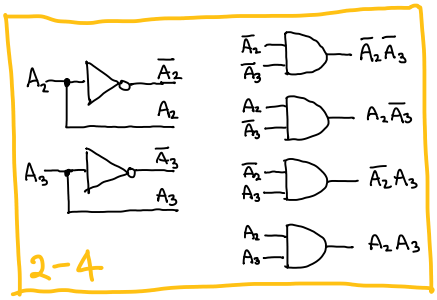
ii) $Z = \Sigma m(1, 3, 5, 7, 8, 9, 14, 15)$

iii)

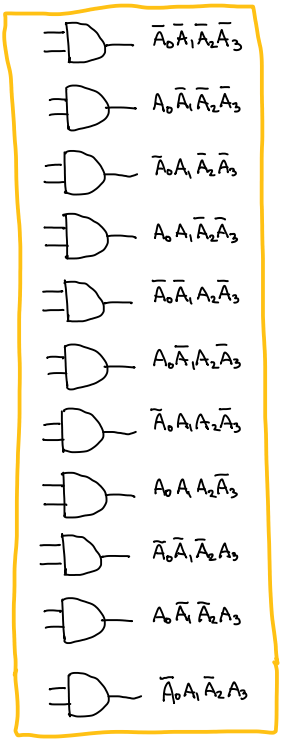


d) Not required



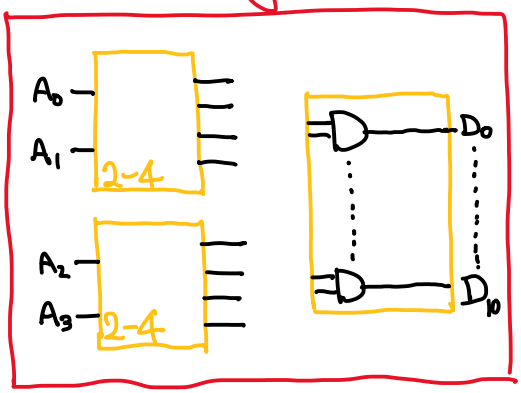


GIC = 4 + 4x2 + 4x2 + 11x2
= 42



11 AND gates

Block diagram



Refer to Week 3 slide 51

- 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.