INDRAPRASTHA INSTITUTE OF INFORMATION TECHNOLOGY, DELHI

ECE111 DC

TUTORIAL 5 (20 marks)

Q1) Consider the following Boolean expressions:

i. $F(a,b,c,d) = a\,c + b\,c + a'b\,c\,d + a'b'\,c + b\,d + b'c'd'$

ii. $F(a,b,c,d) = a'b'c\,d' + ab'cd + ab'cd + abcd$

Write the complete set of essential prime implicants. (2 marks)

Q2) Perform Subtraction using r's complement

i. $(FA50)_{16}$ - $(FBCD)_{16}$

ii. $(7053)_{13}$ - $(9756)_{13}$

iii. $(11011011)_2$ – $(11110001)_2$

iv. $(7564)_8$ – $(7664)_8$

(4 marks)

Q3) Convert the given binary coded decimal (BCD) to Excess-3 and Gray Code.

i. 01011001

ii. 10010011

(2 marks)

Q4. (a) What will be the BCD code and Excess 3 code equivalent of decimal number 6248?

(2 marks)

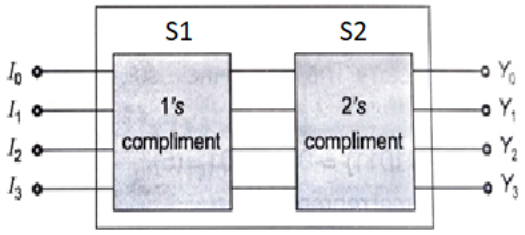
(b) Convert:

i. $(10010)_2$ to gray code

ii. $(11011)_{Gray}$ to Binary code

(2 marks)

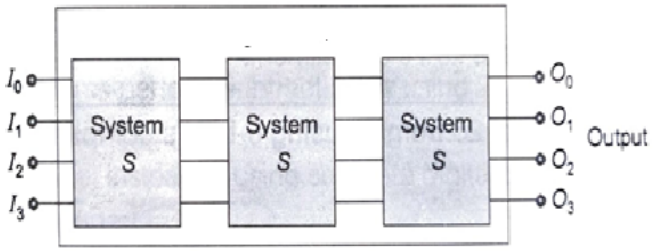
Q5. Consider a System *S* as shown in the figure below:



System S

System *S* performs 1's compliment of the inputs $I_3I_2I_1I_0$. The output of 1's complement is then 2's complimented to produce outputs $Y_3Y_2Y_1Y_0$.

A new System *H* is designed in which three units of System *S* are cascaded.



System H

For the following inputs ($I_3I_2I_1I_0$), find the outputs($O_3O_2O_1O_0$).

i. 1010

ii. 0001

iii. 1111

iv. 1001

(8 marks)

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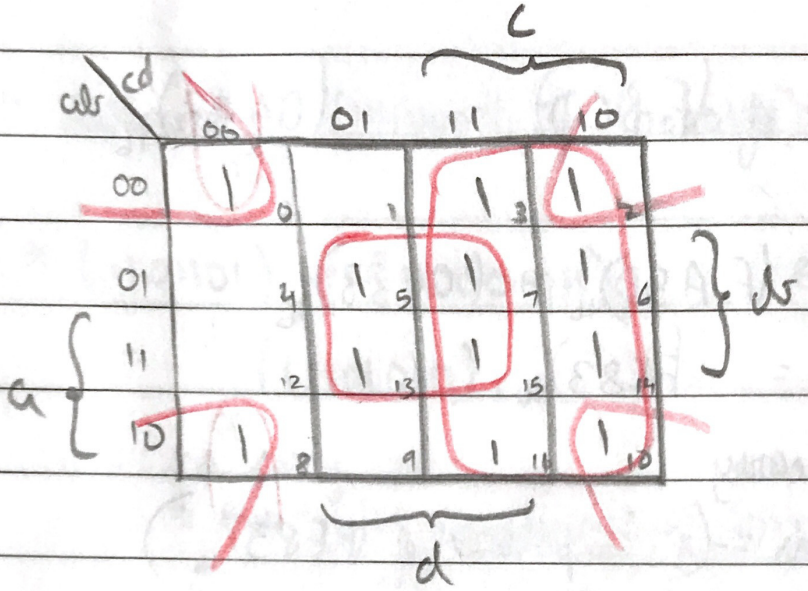
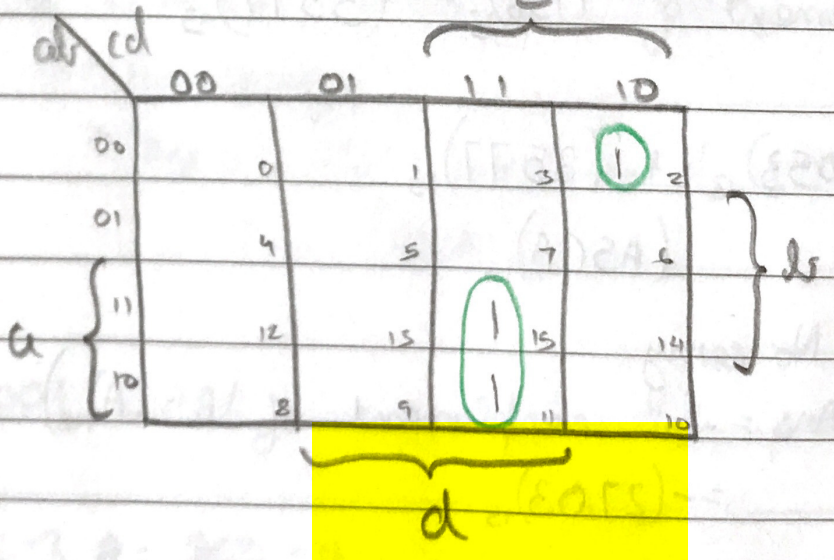
tut-5

Q1 i) $F(a,b,c,d) = ac + bc + a'bcd + a'b'c + bd + b'c'd'$



$F = bd + b'd' + c$

ii) $F(a,b,c,d) = a'b'cd' + ab'cd + abcd + abcd$



$F = acd + a'b'cd'$

Q2) $(FA50)_{16} - (FBCD)_{16}$

r^{th} complement of $(FBCD)_{16} = (0433)_{16}$

⇒ ~~Apply Subtraction~~ ⇒ $(FA50)_{16} + (0433)_{16}$

$= (FE83)_{16}$

∵ No carry

⇒ Ans = $-(r^{th}$ complement of $(FE83)_{16})$

$= -(017D)_{16}$

ii) $(7053)_{13} - (9756)_{13}$

r^{th} complement of $(9756)_{13} = (3577)_{13}$

⇒ $(7053)_{13} + (3577)_{13}$

$= (A5CA)_{13}$

∵ No carry

⇒ Ans = $-(r^{th}$ complement of $(A5CA)_{13})$

$= -(2703)_{13}$

iii) $(11011011)_2 - (11110001)_2$

n^{th} complement of $(11110001)_2 = (00001111)_2$

$\Rightarrow (11011011)_2 + (00001111)_2$

$= (11101010)_2$

∵ no carry

$\Rightarrow$ Ans = $-$(n^{th} complement of $(11101010)_2$)

$= -(00010110)_2$

iv) $(7564)_8 - (7664)_8$

n^{th} complement of $(7664)_8 = (0114)_8$

$\Rightarrow (7564)_8 + (0114)_8 = (7700)_8$

∵ no carry

$\Rightarrow$ Ans = $-$(n^{th} complement of $(7700)_8$)

$= (0100)_8$

Q3 i) 01011001

Excess -3 # = BCD + 11

$\Rightarrow$ Excess 3 = 01011100

Gray code $\Rightarrow$ 001011001

MSB

$\Rightarrow$ Gray Code = 01110101

ii) BCD = 100100 11

Excess -3 = 10010110

Gray Code = 11011010

Q4 a) 6248

Binary BCD

2	6248	0
2	3124	0
2	1562	0
2	781	1
2	390	0
2	195	1
2	97	1
2	48	0
2	24	0
2	12	0
2	6	0
2	3	1
	1	

⇒ BCD = 1100001101000

⇒ Excess-3 = 1100001101011

b) $(10010)_2$ to gray code

$g_4 = b_4 \oplus 0$

$g_3 = b_3 \oplus b_4$

$g_2 = b_2 \oplus b_3$

ii) $g_1 = b_1 \oplus b_2$

$g_0 = b_0 \oplus b_1$

gray code = $(11011)_{gray}$

iii) $(11011)_{gray}$ to BCD

$b_4 = g_4$

$b_3 = b_4 \oplus g_3 = g_4 \oplus g_3$

$b_2 = b_3 \oplus g_2 = g_4 \oplus g_3 \oplus g_2$

$b_1 = b_2 \oplus g_1 = g_4 \oplus g_3 \oplus g_2 \oplus g_1$

$b_0 = b_1 \oplus g_0 = g_4 \oplus g_3 \oplus g_2 \oplus g_1 \oplus g_0$

$\Rightarrow$ Binary code = $(10010)_2$

Q5

S / S1

$x_0 = 1 - I_0$

$x_1 = 1 - I_1$

$x_2 = 1 - I_2$

$x_3 = 1 - I_3$

S2

$y_0 = 1 - x_0 + 1 = I_0 + 1$

$y_1 = 1 - x_1 = I_1$

$y_2 = 1 - x_2 = I_2$

$y_3 = 1 - x_3 = I_3$

$\Rightarrow$ S I $\xrightarrow{S}$ I+1

H

$$I \xrightarrow{S} I+1 \xrightarrow{S} (I+1)+1 \xrightarrow{S} ((I+1)+1)+1$$

$$\Rightarrow \quad I \xrightarrow{H} I+11$$

i) $I = 1010$

$\Rightarrow O = 1010 + 11$

$O = 1101$

ii) $I = 0001$

$\Rightarrow O = 0001 + 11$

$O = 0100$

iii) $I = 1111$

$\Rightarrow O = 1111 + 11$

$= 10010$

But O is only 4-bit

$\Rightarrow O = 0010 = (0,0,0,0_0)$

iv) $I = 1001$

$\Rightarrow O = 1001 + 11$

$O = 1100$