Tutorial 4 (DEC)

Time limit: 20 min

1. a) Find the base (or radix) of the number system for which the equation $\frac{312}{20} = 13.1$ holds true.

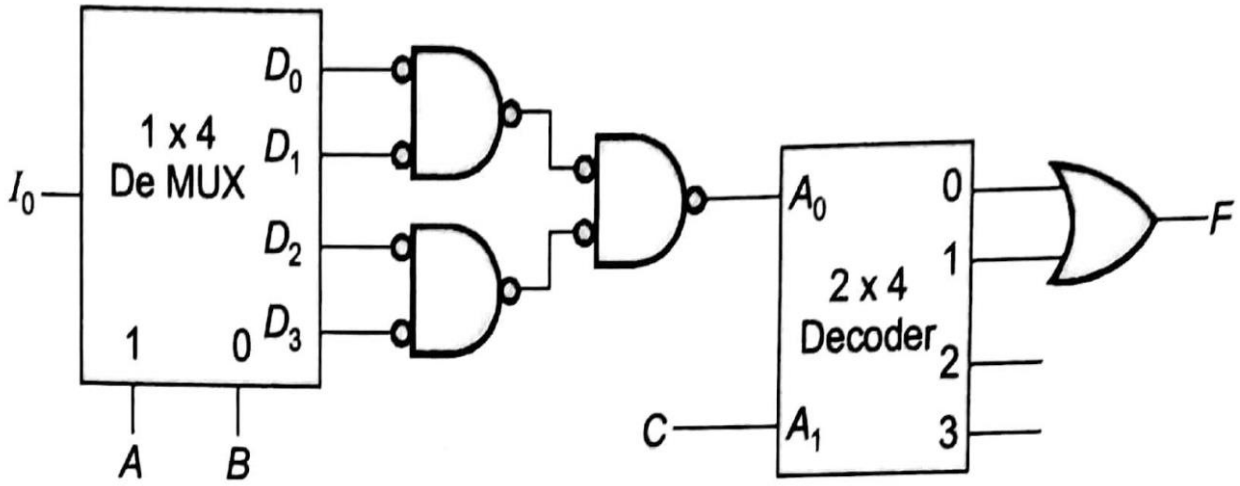
   b) If $(1110212.20211)_3=(X)_9$ then, find out X.

   c) $(235)_a=(565)_{10}=(1065)_b$ Choose the correct options for (a,b) values:

   [A] (a,b)=(3,7) [B] (a,b)=(16,8)

   [C] (a,b)=(7,3) [D] (a,b)=(8,16)

2. Find out the minimized expression of F in the below diagram.



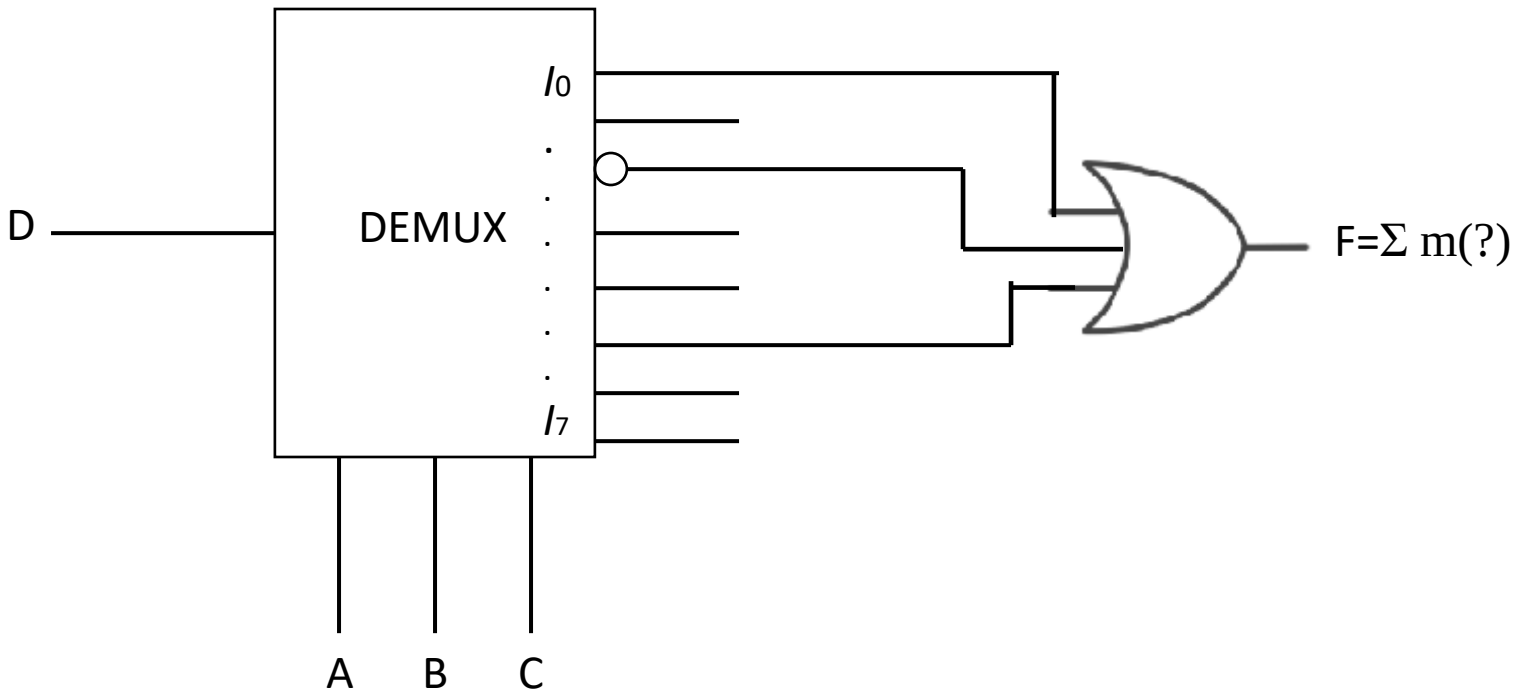
3. a) What is the decimal value representations of binary number 10001001 using *fixed(8,4)* and *fixed(8,2)* point representations*?*

b) Write the precision and range of values (in decimal) that can be represented by *fixed(16,8)* point representation.

4. Implement a 4:2 priority encoder using only 2:1 MUX.

Time limit: 25 min

5. What should be the min-term expression at the output of the given circuit?



Solutions

1. a) Find the base (or radix) of the number system for which the equation $\frac{312}{20}$ = 13.1 holds true.

Q1a)

Symbols used in this equation are 0,1,2,3 Hence base or radix can be 4 or higher

$(312)_x = (20)_x\ (13.1)_x$

$3x^2 + 1x + 2x^0 = (2x+0)\ (x+3x^0+x^{-1})$

$3x^2+x+2 = (2x)\left(x+3+\frac{1}{x}\right)$

$3x^2 + x + 2 = 2x^2 + 6x + 2$

$x^2 - 5x = 0$

$x(x - 5) = 0$

$x = 0$ (or) $x = 5$

But x must be greater than 3. So $x = 5$

1b) If $(1110212.20211)_3=(X)_9$ then, find out X.

1c) $(235)_a=(565)_{10}=(1065)_b$ Choose the correct options for (a,b) values:

[A] (a,b)=(3,7) [B] (a,b)=(16,8) [C] (a,b)=(7,3) [D] (a,b)=(8,16)

Q1b,c)

1b) For base 3, digits are 0, 1, 2, 10, 11, 12, 20, 21, ...

Base 3	Base 9
0 0	0
0 1	1
0 2	2
1 0	3
1 1	4
1 2	5
2 0	6
2 1	7
2 2	8

$\rightarrow (1110212.20211)_3$

$=(01\ 11\ 02\ 12.\ 20\ 21\ 10)_3$

$=(1A25.673)_9$

Alternative

$(1110212.20211)_3 \rightarrow (1076.7572\ldots)_{10}$

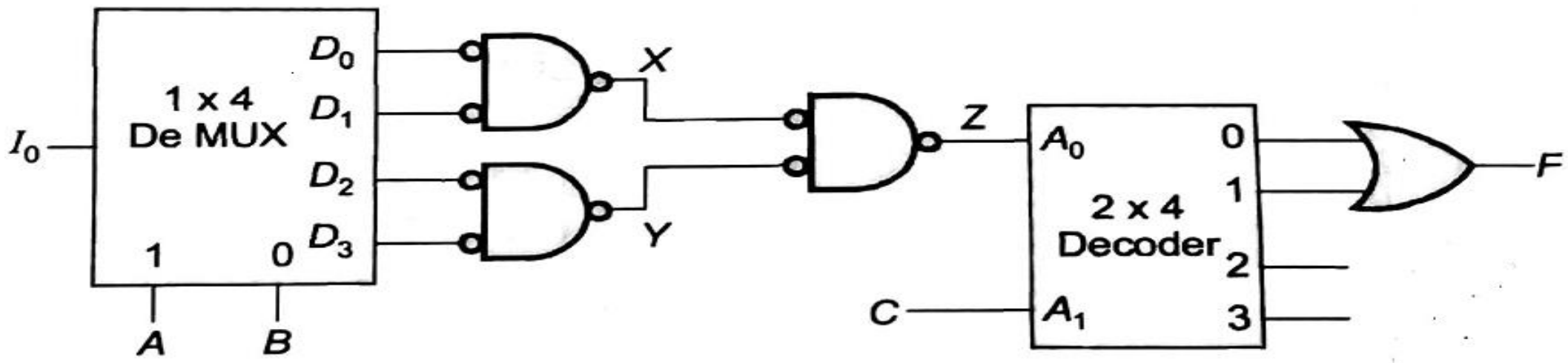
$\downarrow$

$(1A25.673)_9$

1c) Given, $(235)_a=(565)_{10}=(1065)_b$

↳ Since, $235<565 \rightarrow a>10$, $1065>565 \rightarrow b<10$ → only option [B] satisfies this condition

Q2)



$$X = \overline{\bar{D}_0\bar{D}_1}\, I_0 = (D_0 + D_1)I_0 = (\bar{A}\bar{B} + \bar{A}B)I_0 = \bar{A}I_0$$

$$Y = \overline{\bar{D}_2\,\bar{D}_3}\, I_0 = (D_2 + D_3)I_0 = (A\bar{B} + AB)I_0 = AI_0$$

$$Z = \overline{(\bar{X}\cdot\bar{Y})} = X + Y = \bar{A}\cdot I_0 + AI_0 = I_0$$

$$F = (\bar{Z}\bar{C} + Z\bar{C}) = \bar{C}(\bar{I}_0 + I_0) = \bar{C}$$

3. a) What is the decimal value representations of binary number 10001001 using *fixed(8,4)* and *fixed(8,2)* point representations*?*

***b*) Write the precision and range of values (in decimal) that can be represented by *fixed(16,8)* point representation.**

Q3a)

fixed(8,4): $1000.1001 = (1x2^3 + 1x2^{-1} + 1x2^{-4})_{10} = (8.5625)_{10}$

fixed(8,2): $100010.01 = (1x2^5 + 1x2^1 + 1x2^{-2})_{10} = (34.25)_{10}$

Q3b)

Precision= $2^{-8} = 0.00390625$

Fixed(16,8) representation range = $(00000000.00000000 \text{ to } 11111111.11111111)_2$

$= (0 \text{ to } 255.99609375)_{10}$

Or $(0 \text{ to } 2^8 - 2^{-8} = 255.99609375)_{10}$

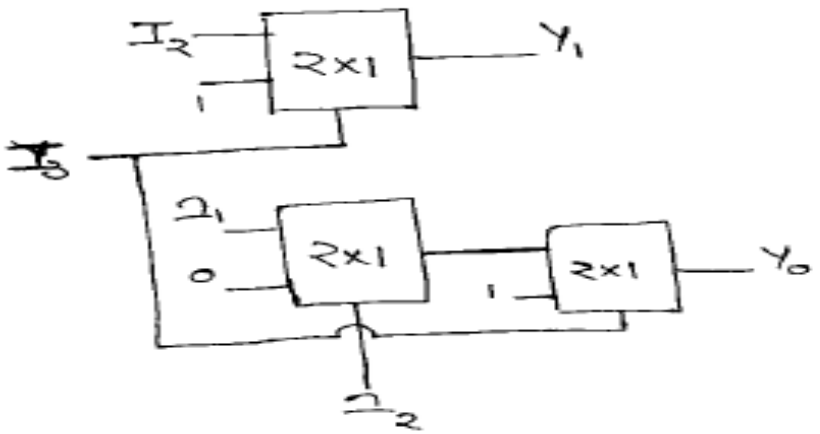
Q4) **Implement a 4:2 priority encoder using only 2:1 MUX**

4x2 Priority encoder :

I_3	I_2	I_1	I_0	Y_1	Y_0
1	x	x	x	1	1
0	1	x	x	1	0
0	0	1	x	0	1
0	0	0	1	0	0

$Y_1 = I_3 + \bar{I}_3 I_2$

$Y_0 = I_3 + \bar{I}_3 \bar{I}_2 I_1$



Concept of Priority Encoder

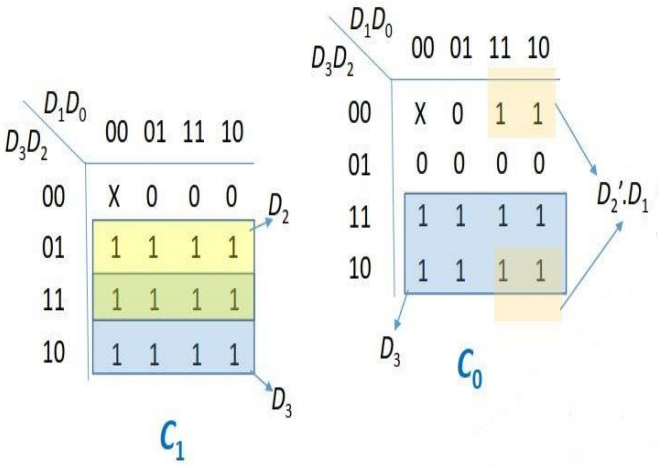
D_3	D_2	D_1	D_0	C_1	C_0
1	X	X	X	1	1
0	1	X	X	1	0
0	0	1	X	0	1
0	0	0	1	0	0

A+A'B=A+B

$C_1 = D_3 + D_2$

$C_0 = D_3 + D_2'.D_1$

(D_1 if not D_2, due to priority)

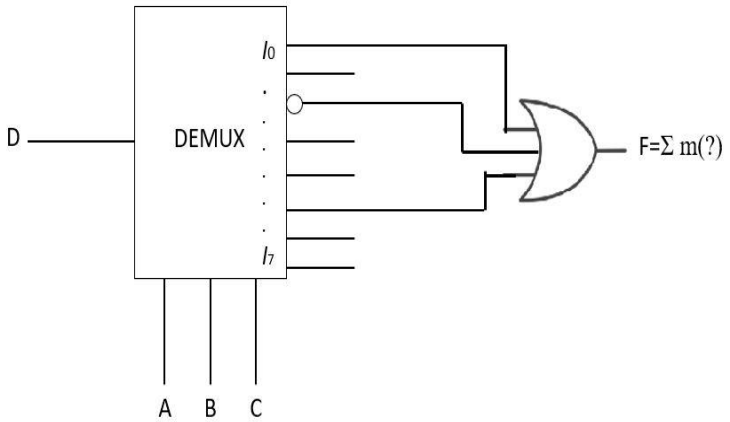


Also, from Karnaugh Map

Using 2-to-1 MUX, the obtained function can be realized in the above fashion.

Q5) The output expression F is,

A	B	C	F
0	0	0	**D**
0	0	1	0
0	1	0	**D'**
0	1	1	0
1	0	0	0
1	0	1	**D**
1	1	0	0
1	1	1	0



$F = \Sigma\, m(1,4,11)$

A	B	C	D	F
0	0	0	0	0
0	**0**	**0**	**1**	**1**
0	0	1	0	0
0	0	1	1	0
0	**1**	**0**	**0**	**1**
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	**0**	**1**	**1**	**1**
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0