

Digital Logic Design (ESC-151)

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Objectives:

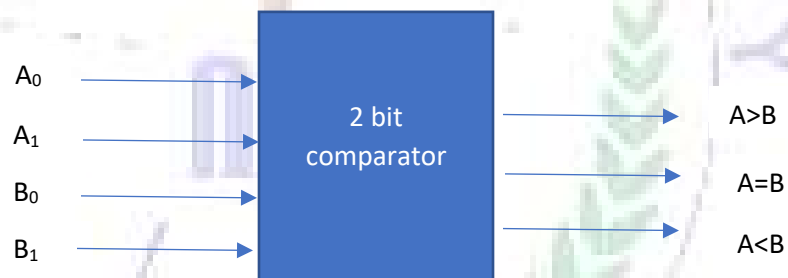
The objective for this week will be to do detailed discussion on combinational circuit designing with practice examples:

- 2 bit comparator
- Even-odd detector
- Count the 1's typed by the user
- 2x4 decoder
- 3x8 decoder
- 4x2 encoder

LECTURE-15

DESIGN A 2 BIT COMPARATOR

Block diagram:



Truth Table:

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Inputs				Outputs		
A ₁	A ₀	B ₁	B ₀	A>B	A=B	A<B
0	0	0	0	0	1	0
0	0	0	1	0	0	1
0	0	1	0	0	0	1
0	0	1	1	0	0	1
0	1	0	0	1	0	0
0	1	0	1	0	1	0
0	1	1	0	0	0	1
0	1	1	1	0	0	1
1	0	0	0	1	0	0
1	0	0	1	1	0	0
1	0	1	0	0	1	0
1	0	1	1	0	0	1
1	1	0	0	1	0	0
1	1	0	1	1	0	0
1	1	1	0	1	0	0
1	1	1	1	0	1	0

Output Equations:

$$\underline{A>B} = A_1'A_0B_1'B_0' + A_1A_0'B_1'B_0' + A_1A_0'B_1'B_0 + A_1A_0B_1'B_0' + A_1A_0B_1'B_0 + A_1A_0B_1B_0'$$

$$\underline{A=B} = A_1'A_0'B_1'B_0' + A_1'A_0B_1'B_0 + A_1A_0'B_1B_0' + A_1A_0B_1B_0$$

$$\underline{A<B} = A_1'A_0'B_1'B_0 + A_1'A_0'B_1B_0' + A_1'A_0'B_1B_0 + A_1'A_0B_1B_0' + A_1'A_0B_1B_0 + A_1A_0'B_1B_0$$

:Simplification:

1. $\underline{A>B} =$

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		A>B			
A₁A₀	B₁B₀	00	01	11	10
	00	0	0	0	0
01	1	0	0	0	0
11	1	1	0	1	0
10	1	1	0	0	0

$$\underline{A > B} = A_0 B_0' + A_1 B_0' B_1' + A_0 A_1 B_1'$$

2. A=B =

		A=B			
A₁A₀	B₁B₀	00	01	11	10
	00	1	0	0	0
01	0	0	1	0	0
11	0	0	0	1	0
10	0	0	0	0	1

$$\underline{A = B} = A_0' A_1' B_0' B_0' + A_0' A_1 B_0' B_1 + A_0 A_1' B_0 B_1' + A_0 A_1 B_0 B_1$$

3. A<B =

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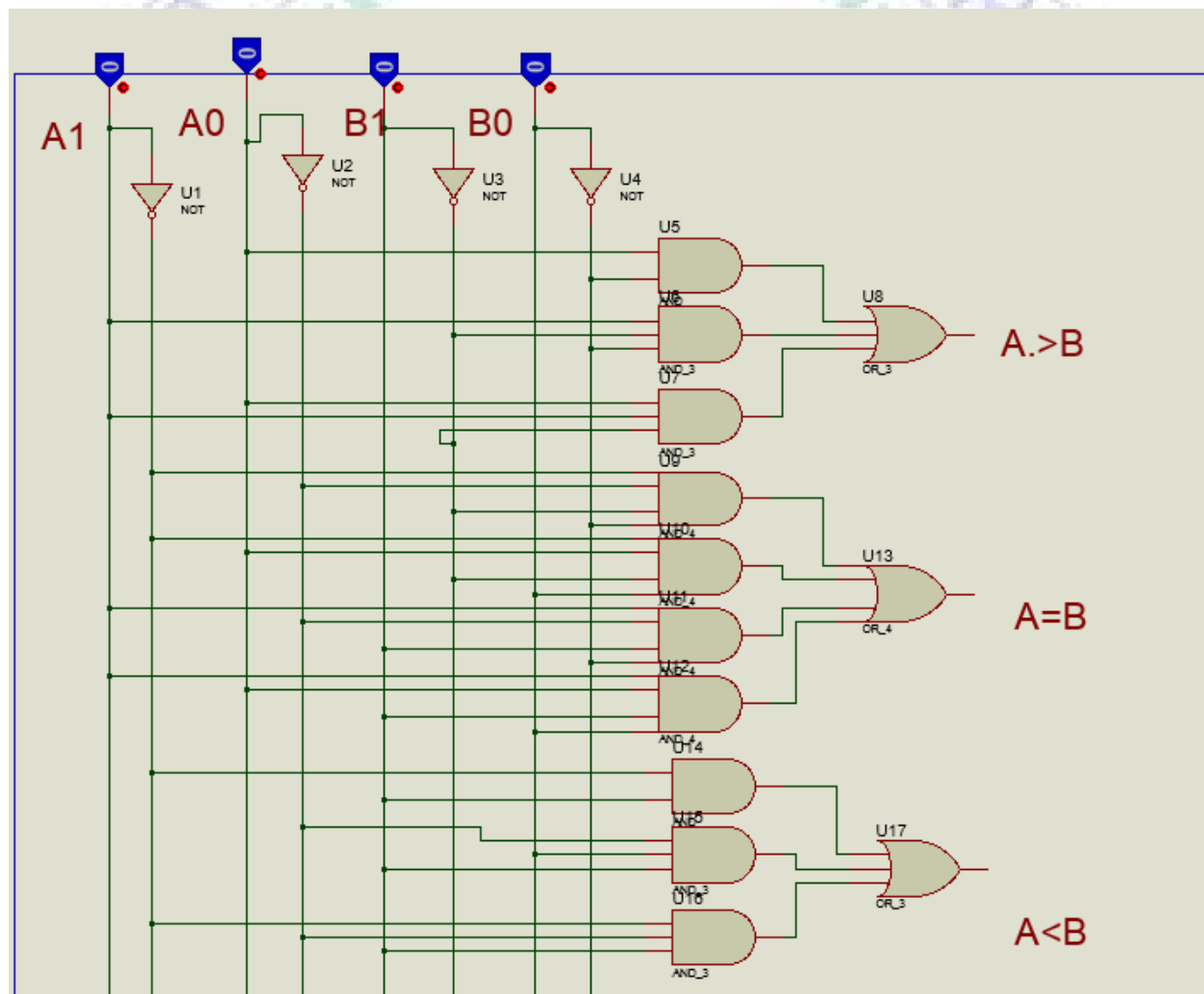
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B ₁ B ₀	00	01	11	10
A ₁ A ₀				
00	0	1	1	1
01	0	0	1	1
11	0	0	0	0
10	0	0	1	0

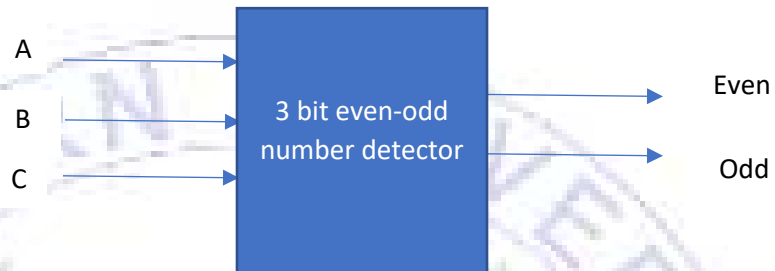
$$A < B = A_1' B_1 + A_0' B_1 B_0 + A_1' A_0' B_1$$

Circuit Diagram:



DESIGN A 3 BIT EVEN-ODD NUMBER DETECTOR

Block Diagram:



Truth Table:

A	B	C	Even	Odd
0	0	0	1	0
0	0	1	0	1
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	1	0
1	1	1	0	1

OUTPUT EQUATIONS:

$$\text{Even} = A'B'C' + A'BC' + AB'C' + ABC'$$

$$\text{Odd} = A'B'C + A'BC + AB'C + ABC$$

:Simplification:

1. Even=

BC	00	01	11	10
A				



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0	1			1
1	1			1

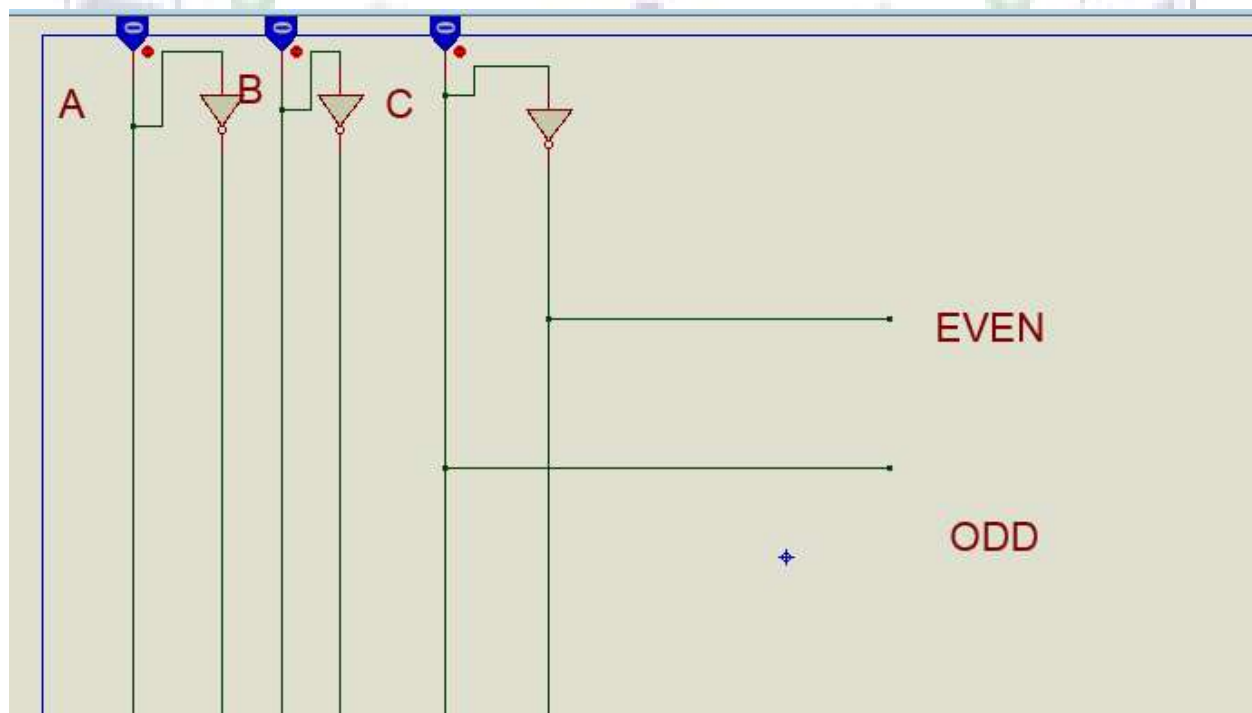
Even = C'

2. Odd=

BC	00	01	11	10
A				
0		1	1	
1		1	1	

Odd=C

Circuit Diagram:



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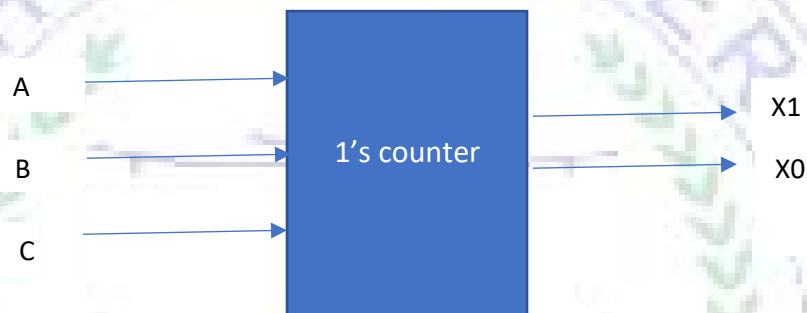
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DESIGN A CIRCUIT THAT COUNTS THE NUMBER OF 1'S PRESENT IN 3 INPUTS A, B AND C. ITS OUTPUT IS A TWO-BIT NUMBER X₁X₀, REPRESENTING THAT COUNT IN BINARY.

Block diagram:



Truth Table:

A	B	C	X ₁	X ₀
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

Output Equations:

$$\underline{X_0} = A'B'C + A'BC' + AB'C' + ABC$$

$$\underline{X_1} = A'BC + AB'C + ABC' + ABC$$

:Simplification:

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1. X0=

BC \ A	00	01	11	10
0		1		1
1	1		1	

already simplified

$$\underline{X0} = A'B'C + A'BC' + AB'C' + ABC$$

2. X1=

BC \ A	00	01	11	10
0			1	
1		1	1	1

$$\underline{X1} = BC + AC + AB$$

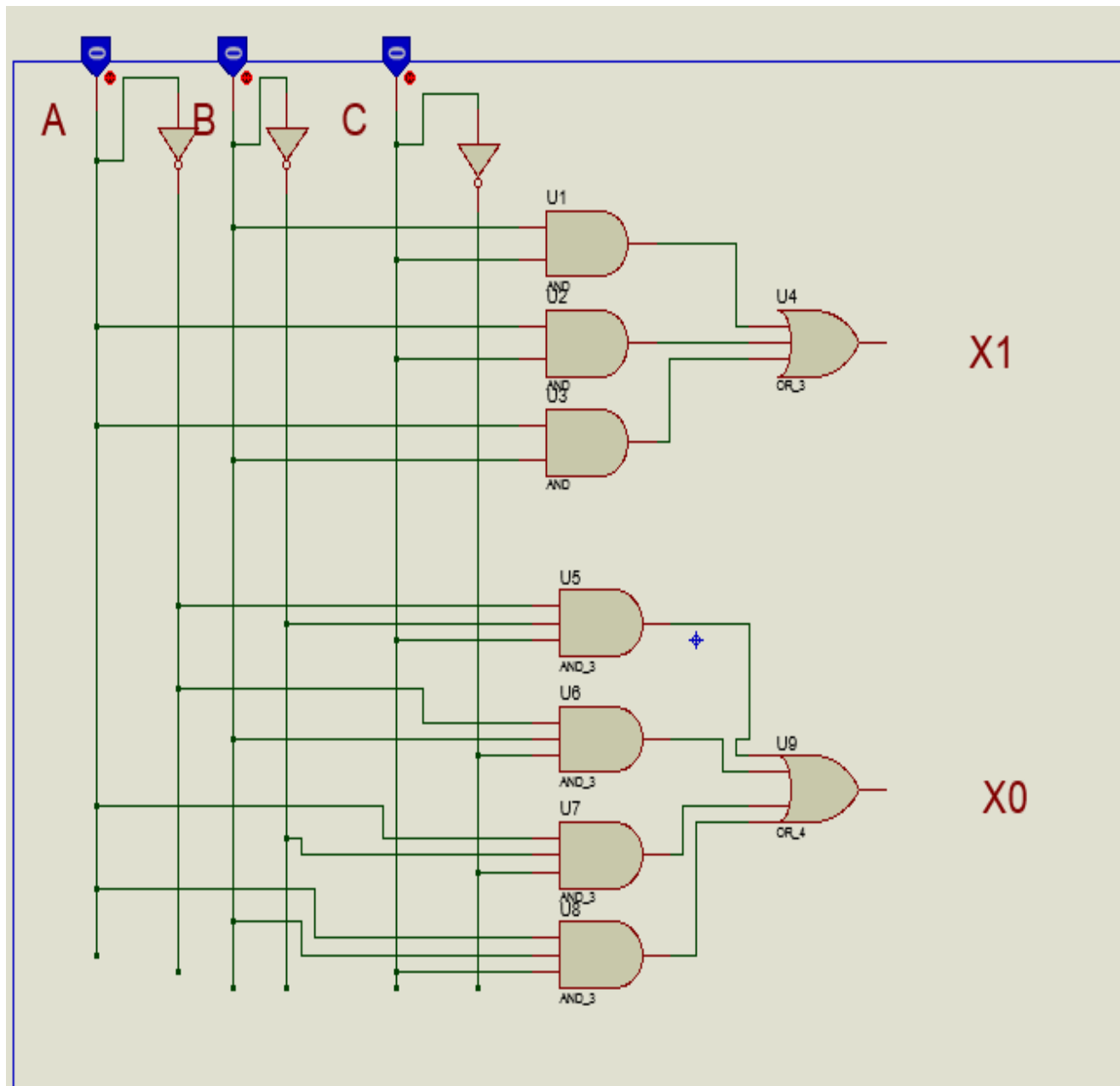
Circuit Diagram:

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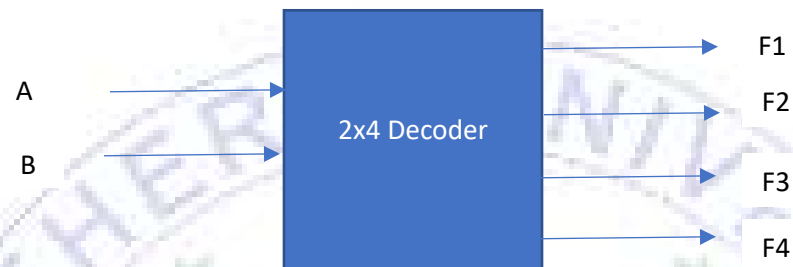
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LECTURE-16
2x4 DECODER

Block diagram:



Truth Table:

A	B	F1	F2	F3	F4
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1

Output Equation:

$$\underline{F1} = A'B'$$

$$\underline{F2} = A'B$$

$$\underline{F3} = AB'$$

$$\underline{F4} = AB$$

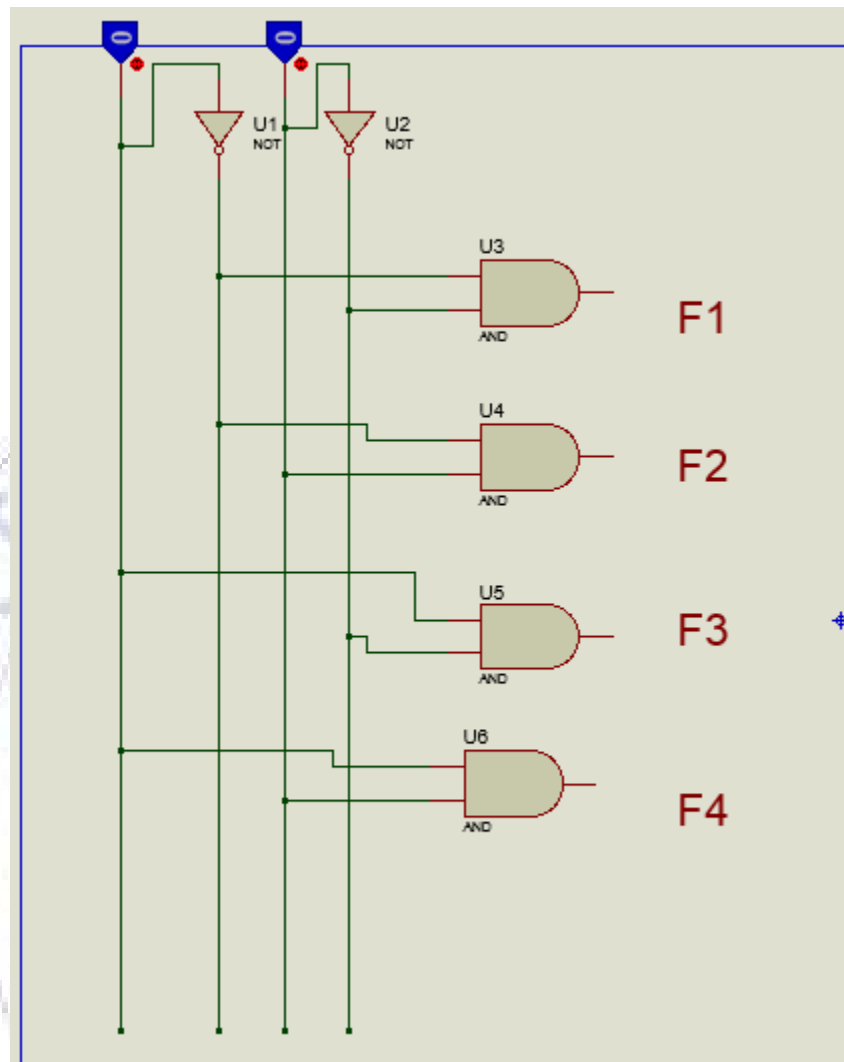
Circuit Diagram:

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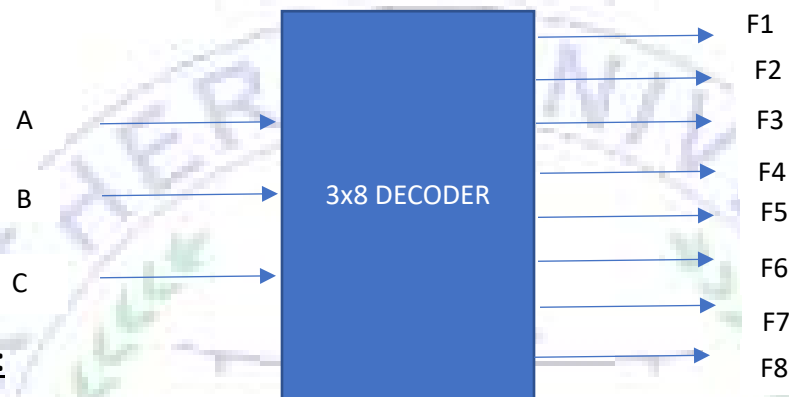
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DESIGN 3x8 DECODER

Block diagram:



Truth Table:

A	B	C	F1	F2	F3	F4	F5	F6	F7	F8
0	0	0	1	0	0	0	0	0	0	0
0	0	1	0	1	0	0	0	0	0	0
0	1	0	0	0	1	0	0	0	0	0
0	1	1	0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	1	0	0	0
1	0	1	0	0	0	0	0	1	0	0
1	1	0	0	0	0	0	0	0	1	0
1	1	1	0	0	0	0	0	0	0	1

Output Equations:

$$\underline{\mathbf{F1}} = \mathbf{A'B'C'}$$

$$\underline{\mathbf{F2}} = \mathbf{A'B'C}$$

$$\underline{\mathbf{F3}} = \mathbf{A'BC'}$$

$$\underline{\mathbf{F4}} = \mathbf{A'BC}$$

$$\underline{\mathbf{F5}} = \mathbf{AB'C'}$$

$$\underline{\mathbf{F6}} = \mathbf{AB'C}$$

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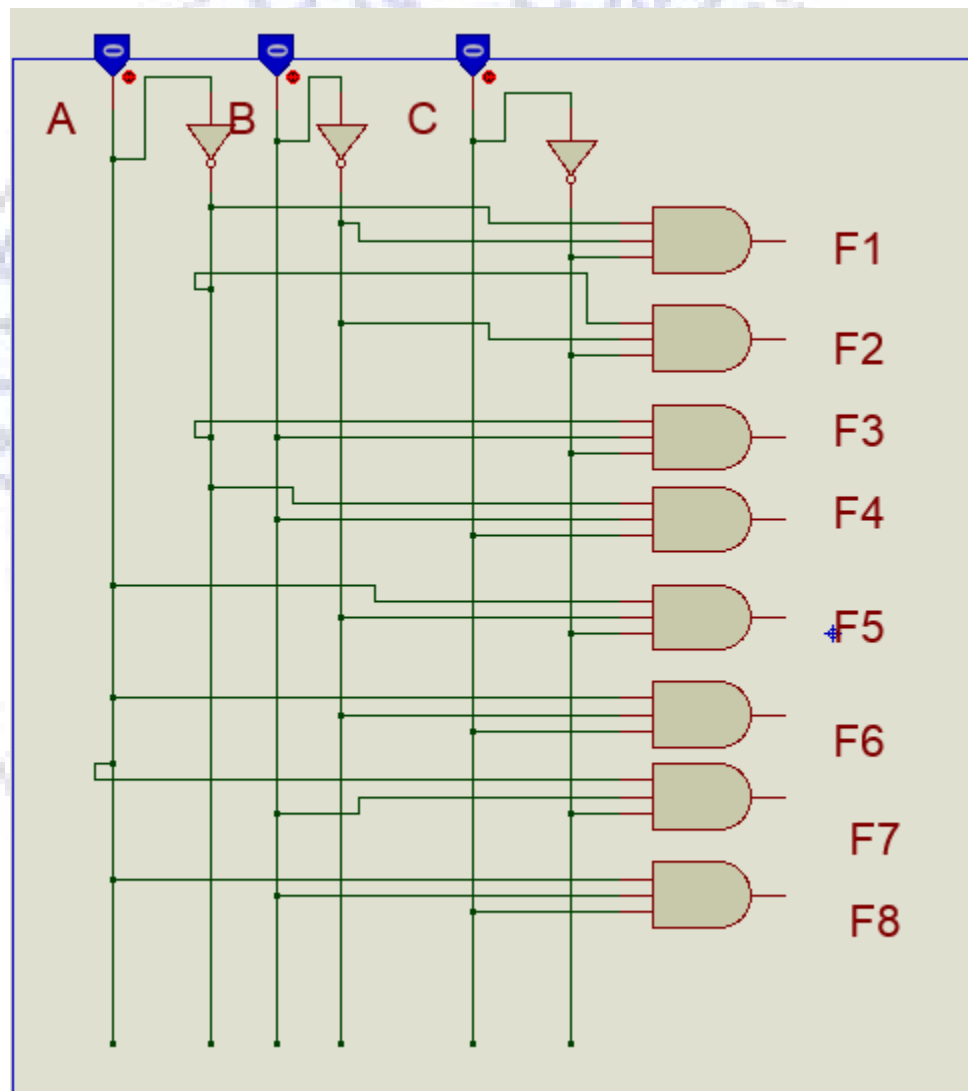
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$$F7 = ABC'$$

$$F8 = ABC$$

Circuit Diagram:



DESIGN A 4x2 ENCODER

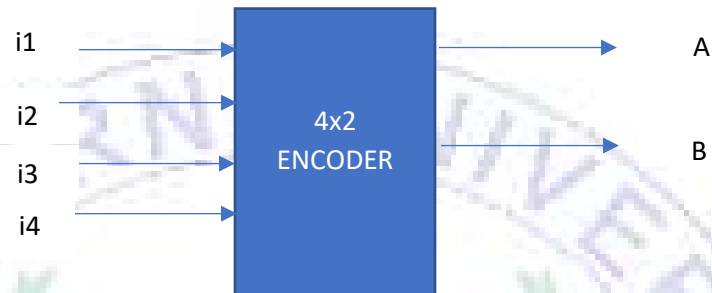
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Block Diagram:



Truth Table:

i1	i2	i3	i4	A	B
1	0	0	0	0	0
0	1	0	0	0	1
0	0	1	0	1	0
0	0	0	1	1	1

Output Equations:

$$\underline{A} = i_1' i_2' i_3 i_4' + i_1' i_2' i_3' i_4$$

$$\underline{B} = i_1' i_2 i_3' i_4' + i_1' i_2' i_3' i_4$$

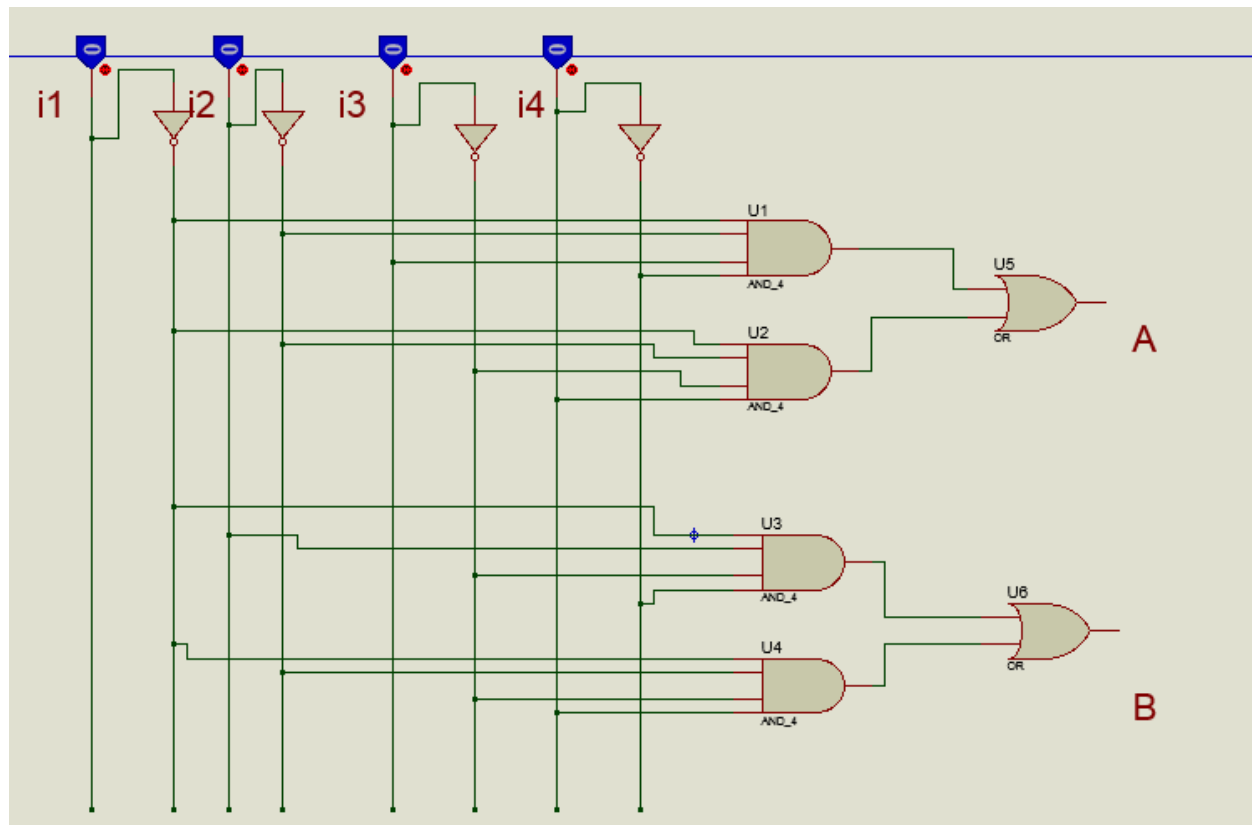
Circuit Diagram:

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Assignment:8

Dear students read the given lectures carefully as per the course objectives mentioned on the top and carryout the assignment as per following instructions

Task to do:

Design following circuits and submit your assignments:

1. 4x16 decoder
2. 3 input 0's counter by user
3. Truth table for 8x3 encoder

Reference Material:

Lesson plans

Text book: Digital design by Moris Mano 4th edition

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Also see digital fundamentals 8th ed by Floyd

Lecture Video Links:

Part-1: <https://www.youtube.com/watch?v=LPAZ99jZBG0>

Part-2: https://www.youtube.com/watch?v=XikfKCA_WbI

Part-3: <https://youtu.be/EN1KrQqvwqA>

Part-4: https://youtu.be/nyDy_-9fQ2k

Part-5: <https://youtu.be/de3TlGFKFSg>

Part-6: <https://youtu.be/h9FYMdFQwGQ>

Part-7: <https://youtu.be/WyyCTT6Lq94>

Lab Work-1: <https://youtu.be/JeTQJ1BTG4Q>

Lab Work-2: <https://youtu.be/65JvLf5-U5I>

Lab Work-3: <https://youtu.be/pkRM30kqYHA>

LAB Work:

Design circuits of given assignments on proteus and send screenshots to Mr Hamza Sakhi via email at hamzasakhic97@gmail.com

Lab manuals have been uploaded on whatsapp and Edmodo library section.