

Digital Logic Design (ESC-151)

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Note:

It is intimated that following Lectures will not be repeated and would be part of mid-term & final exam as well.

Objectives:

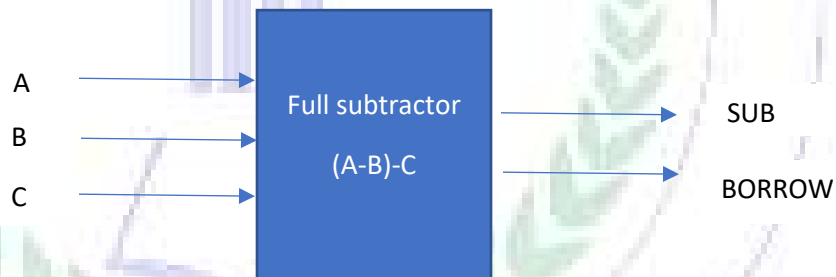
The objective for this week will be to do detailed discussion on combinational circuit designing with practice examples:

- Full subtractor
- 3 bit incrementor
- 3 bit 1's compliment
- 3 bit 2's compliment
- Even number detector
- Odd number detector

LECTURE-13

DESIGN A FULL SUBTRACTOR

Block diagram:



Truth Table:

A	B	C	SUB	BORROW
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

Output Equations:

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

$$\underline{\text{BORROW}} = A'B'C + A'BC' + A'BC + ABC$$

:Simplification:

1. SUB=

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

already simplified

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

2. BORROW=

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

$$\underline{\text{BORROW}} = BC + A'C + A'B$$

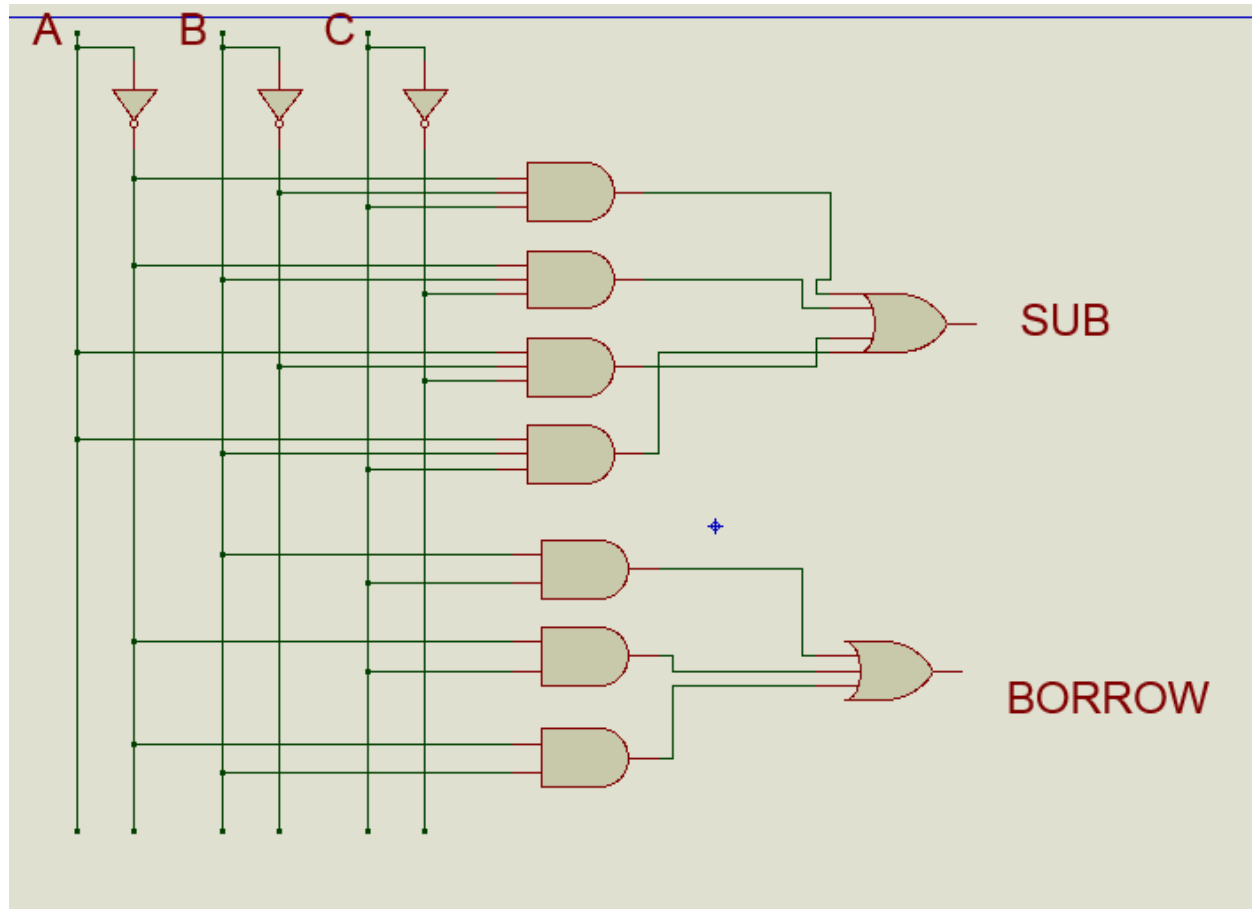
Circuit Diagram:

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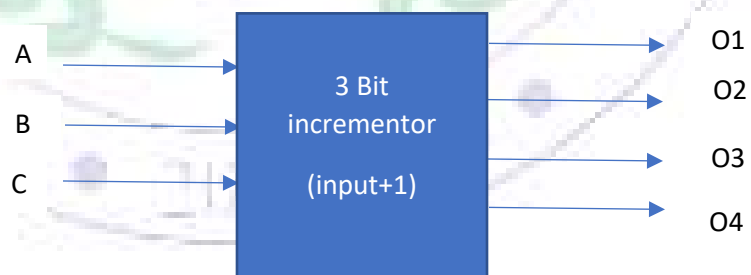
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DESIGN A 3 BIT INCREMENTOR

Block Diagram:



Truth Table:

A	B	C	O1	O2	O3	O4
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0	0	0	0	0	0	1
0	0	1	0	0	1	0
0	1	0	0	0	1	1
0	1	1	0	1	0	0
1	0	0	0	1	0	1
1	0	1	0	1	1	0
1	1	0	0	1	1	1
1	1	1	1	0	0	0

OUTPUT EQUATIONS:

$$O1 = ABC$$

$$O2 = A'BC + AB'C' + AB'C + ABC'$$

$$O3 = A'B'C + A'BC' + AB'C + ABC'$$

$$O4 = A'B'C' + A'BC' + AB'C' + ABC'$$

:Simplification:

1. O1 = ABC

2. O2 =

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

$$O2 = A'BC + AB' + AC'$$

3. O3 =

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

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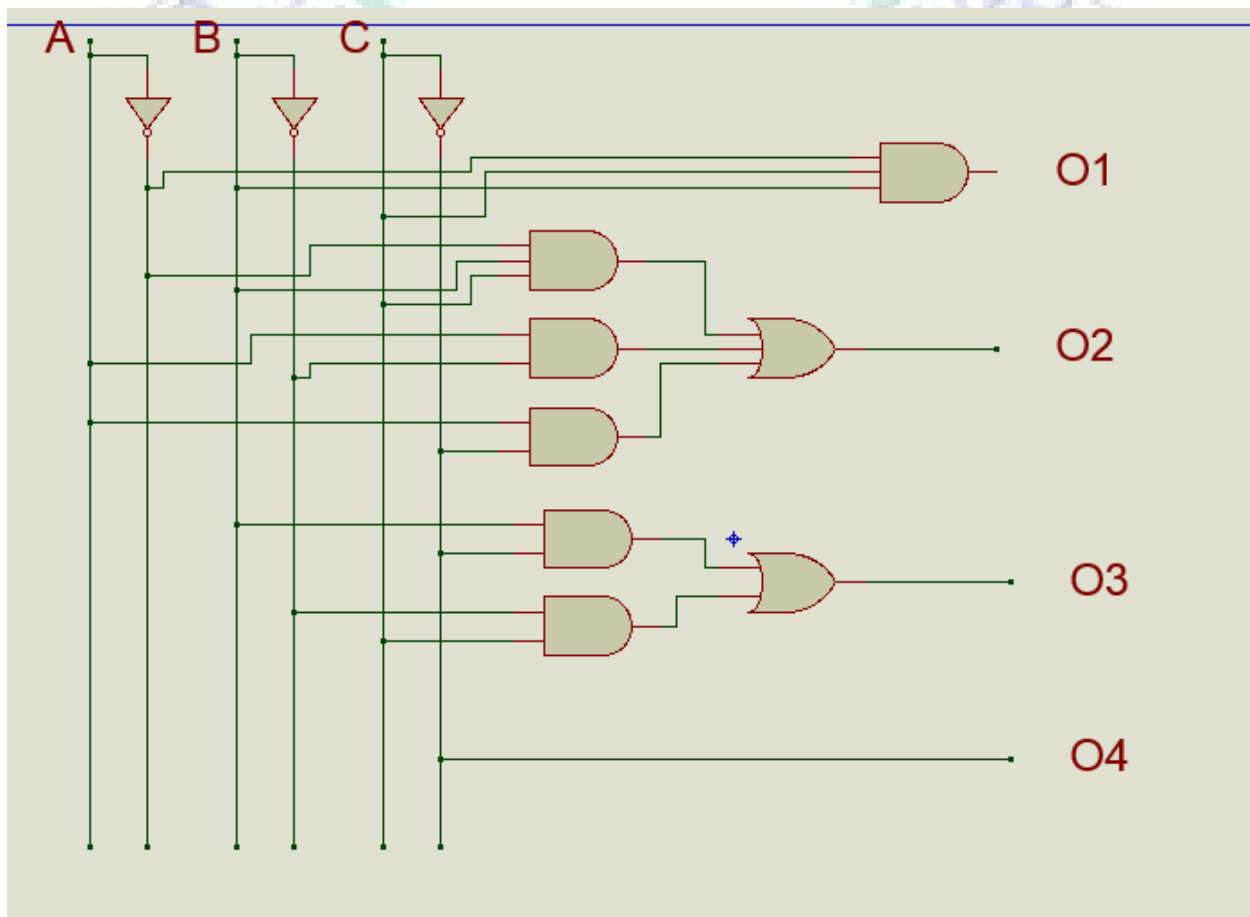
$$O3 = B'C + BC'$$

4. O4=

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

$$O4 = C'$$

Circuit Diagram:



3 BIT 1'S COMPLIMENT

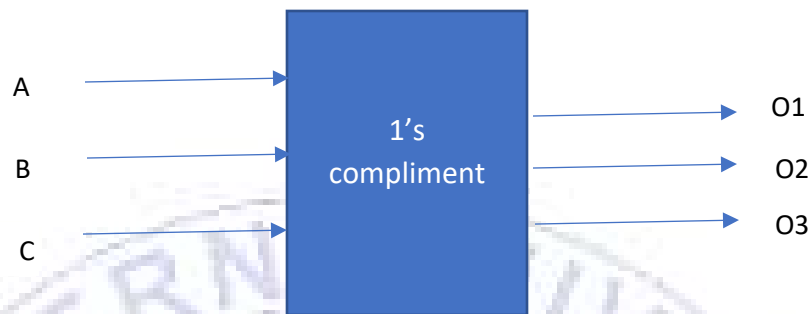
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Block diagram:



Truth Table:

A	B	C	O1	O2	O3
0	0	0	1	1	1
0	0	1	1	1	0
0	1	0	1	0	1
0	1	1	1	0	0
1	0	0	0	1	1
1	0	1	0	1	0
1	1	0	0	0	1
1	1	1	0	0	0

Output Equations:

$$\underline{\mathbf{O1}} = \mathbf{A'B'C' + A'B'C + A'BC' + A'BC}$$

$$\underline{\mathbf{O2}} = \mathbf{A'B'C' + A'B'C + AB'C' + AB'C}$$

$$\underline{\mathbf{O3}} = \mathbf{A'B'C' + A'BC' + AB'C' + ABC'}$$

:Simplification:

1. $\mathbf{O1=}$

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BC A	00	01	11	10
0		1	1	1
1				

$$\underline{O1} = A'$$

2. O2=

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

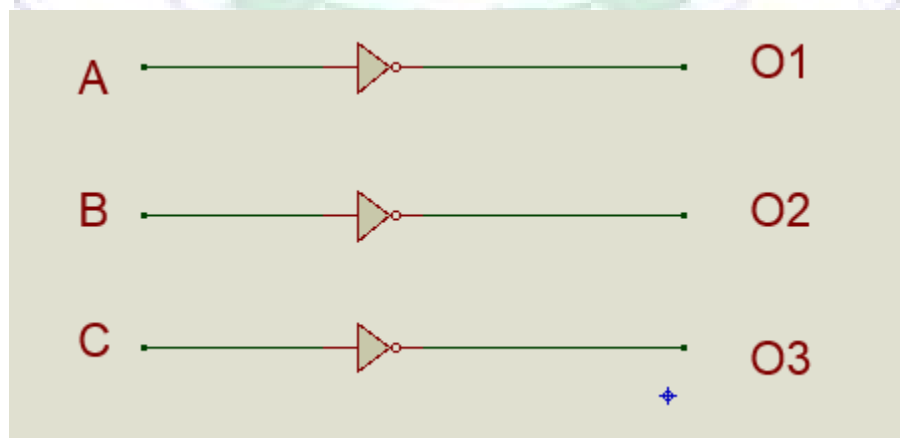
$$\underline{O2} = B'$$

3. O3=

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

$$\underline{O3} = C'$$

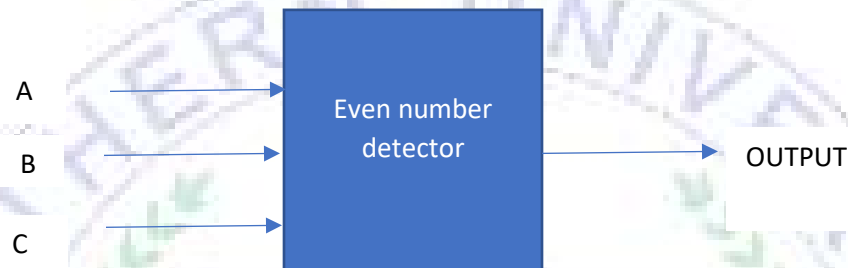
Circuit Diagram:



LECTURE-14

3 BIT EVEN NUMBER DETECTOR

Block diagram:



Truth Table:

A	B	C	OUTPUT
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

Output Equation:

OUTPUT = $A'B'C' + A'BC' + AB'C' + ABC'$

:Simplification:

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

Blue brackets are drawn under the '1's in the first column (A=0) and the first row (C=0), indicating the simplification to C'.

Output = C'

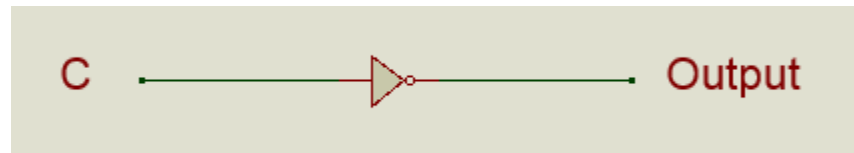
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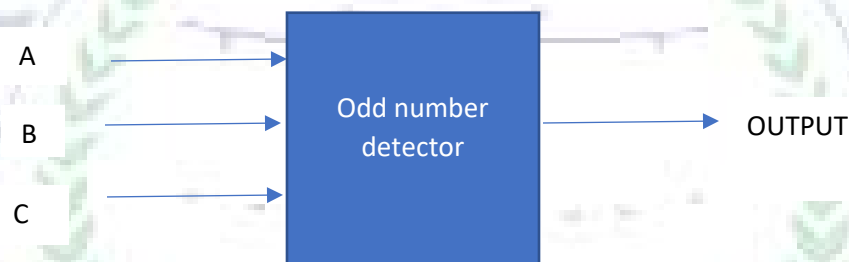
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Circuit Diagram:



DESIGN 3 BIT ODD NUMBER DETECTOR

Block diagram:



Truth Table:

A	B	C	OUTPUT
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

Output Equations:

OUTPUT = $A'B'C + A'BC + AB'C + ABC$

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:Simplification:

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

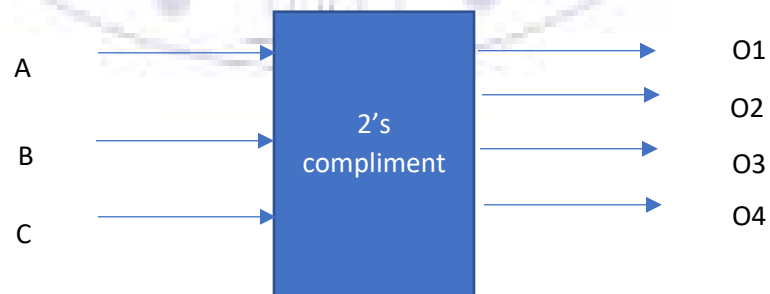
OUTPUT= C

Circuit Diagram:

C _____ Output

3 BIT 2'S COMPLIMENT

Block Diagram:



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Truth Table:

A	B	C	O1	O2	O3	O4
0	0	0	1	0	0	0
0	0	1	0	1	1	1
0	1	0	0	1	1	0
0	1	1	0	1	0	1
1	0	0	0	1	0	0
1	0	1	0	0	1	1
1	1	0	0	0	1	0
1	1	1	0	0	0	1

Output Equations:

O1=A'B'C'

O2=A'B'C+A'BC'+A'BC+AB'C'

O3=A'B'C+A'BC'+AB'C+ABC'

O4=A'B'C+A'BC+AB'C+ABC

:Simplification:

1. O1=A'B'C'

already simplified

2. O2=

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

O2=AB'C'+A'C+A'B

3. O3=

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

$$\underline{O3} = B'C + BC'$$

4. O4=

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

$$\underline{O4} = C$$

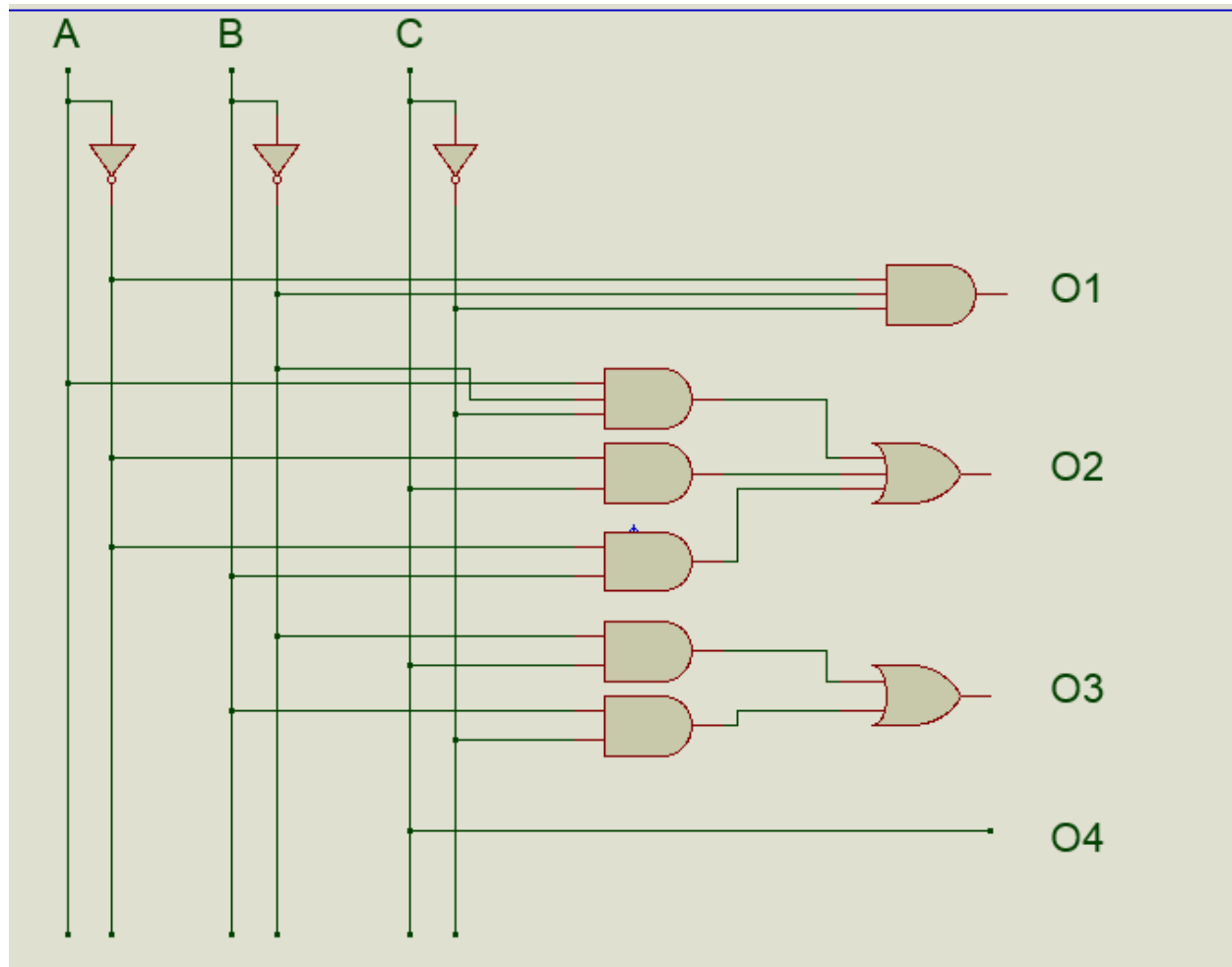
Circuit Diagram:

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Assignment:7

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. 4 bit prime number detector
2. 4 bit 2's compliment

Reference material:

Lesson plans

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Text book: Digital design by Moris Mano 4th edition

Also see digital fundamentals 8th ed by Floyd

Lecture Video Links:

Part-1: <https://youtu.be/LHWIWTNC0wg>

Part-2: <https://youtu.be/awsGwSIoRFg>

Part-3: <https://youtu.be/Kt7sN5siGxc>

Part-4: <https://youtu.be/9LzN7xuWBmA>

Part-5: <https://youtu.be/07hLgOJ4zt8>

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

Part-7: <https://youtu.be/LSQ-0SslfE0>

LAB Work:

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

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