



Digital Design : 2020-21 Lab 1

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Outline

- Review of Digital Gates
- Digital Logic families
- ➢ Few 74XX series TTL Digital ICs
- Procedure for installation of LT SPICE
- Problem definition for DD: Lab 1

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> Demonstration of LT SPICE installation and simulation.

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Review of Digital Gates





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Review of Digital Gates



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Review of Digital Gates



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Digital Logic families

- Diode Transistor Logic
- Resistor Transistor Logic
- Transistor Transistor Logic : 1963 Discrete IC
- Emitter-coupled logic

:1961

: 1959

- : First Microprocessor 360

- CMOS :
 - 1974 Intel 4004 which had 2000 Transistors Channel Length of 10 µm.
 - 2020 AMB 7 nm has billions of Transistors Channel Length of 7 nm.



74XX Series TTL ICs

7400 Quad 2 Input NAND



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74XX Series TTL ICs

7400 NAND

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TTL Gate



TTL 2 input NAND Gate

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74XX Series TTL ICs

7400 NAND DATA SHEET

Quad 2-I	nput NAN	ID Gates				
General De	• escription					
This device conta performs the logic	ins four independent NAND function.	t gates each of which				
Ordering C	ode:					
Order Number	Package Number		Package Desc	ription		
DM7400M	M14A	14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow				
DM7400N	N14A	14-Lead Plastic Dual-I	n-Line Package (PDIP),	JEDEC MS-00	1, 0.300" Wide	
evices also available	in Tape and Reel. Specify	v by appending the suffix lette	r "X" to the ordering code.			
Connectio	n Diagram		Function Tab	le		
V _{CC} B4	A4 Y4	63 A3 Y3		Y = AB		
14 13	12 11	10 9 8	Inc	outs	Output	
			A .	В	Y	
			L	L	н	
	പ		L	н	н	
			н	L	н	
_		_	н	н	L	
)n [F	-	H = HIGH Logic Level			
			L - LOW Logic Level			
4						
	3 4	5 6 7				

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74XX Series TTL ICs

7400 NAND DATA SHEET

Recommended Operating Conditions

Symbol	Parameter	Min	Nom	Max	Units
V _{CC}	Supply Voltage	4.75	5	5.25	V
V _{IH}	HIGH Level Input Voltage	2			V
V _{IL}	LOW Level Input Voltage			0.8	V
I _{OH}	HIGH Level Output Current			-0.4	mA
I _{OL}	LOW Level Output Current			16	mA
T _A	Free Air Operating Temperature	0		70	°C

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74XX Series TTL ICs

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7400 NAND



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7400 NAND MODEL IN LT SPICE



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MODELS IN LT SPICE



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74XX Series TTL ICs

MODELS IN LT SPICE



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Procedure for Installation of LT SPICE

Installing 74XX SPICE Model in LT SPICE

- 1. Download file "LT_SPICE_Installation_Files.zip" from https://sanjayvidhyadharan.in/Downloads
- 2. Unzip the file. It contains the following files/folder

 (a) Itspiceiv.exe
 (b) 74hct.lib
 (c) Sym (Folder)
 (d) Example1.asc
- 3. Run the Itspiceiv.exe file to install LTSPICE on to your PC/laptop.

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Procedure for Installation of LT SPICE

4. Open LtSpice. And open a New Schematic from File tab.

🗸 LTspice IV					
<u>File View Tools H</u> elp					
New Schematic	1 <u>0</u>	- 4	5 X	ß	两
New Symbol	 1				
🗃 <u>O</u> pen					
New <u>L</u> ibrary					
Print Setup					
1 C:\Users\\Draft2.asc					
2 Draft2.asc					
3 C:\Users\\22nm_VTC.asc					
4 C:\Users\\90nm_VTC.asc					
5 C:\Users\\45nm_VTC.asc					
6 Dynamic_Full_Adder.asc					
7 Domino Full Adder.asc					
8 28T_Full_Adder_new.asc					
9 28T_Full_Adder_Corrected.asc					
0 28T_Full_Adder.asc					
1 C:\Users\\full adder.asc					
2 C:\Users\\28Tx_FullAdd.asc					
E <u>x</u> it					

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5. Click on the Component tab (looks like a AND gate) on the new schematic window

Traice IV - [Draft2 asc]			
Lipice W [United ase]	ndow Help		
] 🖻 📽 🖶 😤 🛠 🕛 C, Q, Q, 🕅 🔛 !	💷 🖻 🖥 📽 🛛 🕹 🛍 🛤	@@ / →@<+3文	₽~~~
	C Select Component Symbol Top Directory: C:\Program Files ((x86)\LTC\LTspicelV\lib\sym	
	Comparators] 74hct04 [Digital] 74hct08 [FilterProducts] 74hct107 [Misc] 74hct105 [Optos] 74hct165 [Optos] 74hct283 [PowerProducts] 74hct283 [PowerProducts] 74hct283 [References] 74hct74 [SpecialFunctions] 74hct86 74hct00 bi 74hct02 bi2 < Cancel	bv FerriteBo cap g cmosn g2 cmosp h csw ind current ind2 diode LED e load e2 load e2 load f lonp FerriteBead Ittine	

6. Note the path of the LT SPICE lib file

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7. Copy paste 74ct.lib file in the folder

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C:\Program Files\LTC\LTspiceIV\lib\sub

8. Copy paste all the files contained in downloaded folder "Sym" into

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C:\Program Files\LTC\LTspiceIV\lib\sym



9. Click on the SPICE Directive tab as shown below:-



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9. Click on the SPICE Directive tab as shown below:-



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10. Select SPICE Directive and Type .INCLUDE 74hct.lib

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I Edit Text on the Schematic:	×
How to netlist this text Justification Font Size O Comment Left 1.5(default) Image: SPICE directive Image: Vertical Text Image: Vertical Text	OK Cancel
.INCLUDE 74hct.lib	<u> </u>
Type Ctrl-M to start a new line.	

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Procedure for Installation of LT SPICE

10. Place the SPICE directive on the schematic

IV - [Draft2.asc]								
<u>E</u> dit H <u>i</u> erarchy	<u>V</u> iew <u>S</u> imulate	<u>T</u> ools <u>W</u> indow <u>H</u> elp						
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🗸 Select Compone	ent Symbol		×					
Top Directory: C:	VProgram Files (x86)	\LTC\LTspicelV\lib\sym	\sim		.INCL	UDE	74h0	ct.lib
		2-input NAND gate						
		Open this macromodel's 74hct00 IV/Jib/sum/	test fixture					
[Comparators] [Digital] [FilterProducts] [Misc] [Optos] [PowerProducts] [References] [SpecialFunctions] 74hct00 74hct02 <	74hct04 74hct08 74hct107 74hct165 74hct166 74hct283 74hct32 74hct32 74hct32 bi bi2	bv cap cmosp csw current diode e e2 f FerriteBead	FerriteBe g g2 h ind ind2 LED load load2 load2 lpnp Itline					
	IV - [Draft2.asc] Edit Hjerarchy III IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	IV - [Draft2.asc] Edit Hjerarchy View Simulate I P P X P P Q Q Q 7 Select Component Symbol Top Directory: C:\Program Files (x86) C:\Program Files (x86)\LTC\LT spice C:\Program Files (x86)\LTC\LT spice (Comparators) 74hct04 [Digital] 74hct08 FilterProducts] 74hct105 [Opamps] 74hct165 [Opamps] 74hct165 [Opamps] 74hct165 [Opamps] 74hct165 [Opamps] 74hct165 [Opamps] 74hct165 [Opamps] 74hct165 [Opamps] 74hct233 PowerProducts] 74hct233 PowerProducts] 74hct32 References] 74hct32 [References] 74hct32 [References] 74hct32 [References] 74hct32 [SecialFunctions] 74hct34 [SecialFunctions] 74hct35 [SecialFunctions] 74hct34 [SecialFunctions] 74hct35 [SecialFunctions] 74hct35 [SecialFunctions] 74hct35 [SecialFunctions] 74hct34 [SecialFunctions] 74hct34 [SecialFunctions] 74hct34 [SecialFunctions] 74hct35 [SecialFunctions] 74hct34 [SecialFunctions] 74hct35 [SecialFunctions] 74hct	IV - [Draf2.asc] Edit Hjerarchy View Simulate Jools Window Heip Image: Strain	V - [Draf2.asc] Edit Hjerarchy Yiew Simulate Jools Window Help Image: State of the state	V - [Draft2.asc] Edit Hjerarchy Yiew Simulate Jools Window Help Image: Simulation of the state of the	V - [Draft2.asc] Edit Hjerarchy Yiew Simulate Jools Window Help Image: State Sta	VI-(Draft2.asc) Édit Hjerarchy Vjew Simulate Jools Window Heip Image: State of the state	V - [Draft2.acc] Edit Hjerarchy Yew Simulate Jools Window Help Image: State Stat

11. Select the component tab and you will be able to see the 74XX series gates.

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Sample Run

F=AB+C (Implementation with AND & OR Gates)



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Sample Run

F=AB+C (Implementation with AND & OR Gates)



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Sample Run

F=AB+C (Implementation with AND & OR Gates)

5 01/					V(a)					
5.00										
4.0V-										
3.0V-										
2.0V-										
1.0V-										
0.0V										
5.0V										
4.0V-										
3.0V-										
2.0V-										
1.0V-										
0.0V-										
5.0V-					V(c)					
4.0V-										
3.0V-										
2.0V-										
1.0V-										
0.01/-										
5.5V-					V(f)					
4.5V-										
3.5V-										
2.5V-										
1.5V-										
0.5V-										
-0.5V										
0.0µ	s 0.8µs	1.6µs	2.4µs	3.2µs	4.0μs	4.8µs	5.6µs	6.4µs	7.2µs	8.0µs

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Sample Run

F=AB+C (Implementation with NAND Gates)





Sample Run F=AB+C Implementation with NAND Gates





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Problem 1: Implement the Majority Circuit

Α	B	С	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

F = AB + BC + CA + ABC

F = AB + BC + CA

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Problem 1: Implement the Majority Circuit Run1 : Implement F with AND & OR gates Check output for all combinations of Input F= AB+BC+CA Hint: Use Three 2 i/p AND & Two 2 i/p OR GATE



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Problem definition for DD: Lab 1

Problem 1: Implement the Majority Circuit

Run1 : Implement F with NAND gates

F = AB + BC + CA

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Check output for all combinations of Input

Hint: Use Three 2 i/p NAND & One 3 i/p NAND GATE

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Submission



Upload LTSPICE file to the folder given by your Lab instructor

1. With your name in the schematic as shown above

2. LT Spice File name indicating your Roll number

Eg. 2019H1240056H.asc

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Demonstration

8/6/2020

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