



Digital Design

Lecture 1: Introduction to Digital Design

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Text Books

- T1: M.Moris Mano and Michael D. Ciletti “ Digital Design”, Pearson, 5th Edition, 2013.
- Reference Books:
 - R1. Neal S. Widmer, Gregory L. Moss & Ronald J. Tocci, “Digital Systems Principles and Applications” Pearson, 12th Edition, 2018.
 - R2. Charles H. Roth, Jr. and Larry L. Kinney “Fundamentals of Logic Design” Cengage Learning 7th Edition, 2013.
 - R3: M.Moris Mano and Michael D. Ciletti “ Digital Logic and Computer Design”, Pearson,, e-Book, 2016.

Course Content

Lect. No.	Learning Objectives	Topics to be covered	Reference to Text Book
1	Introduction to Digital Systems and Characteristics of Digital ICs.	Discussion on course curriculum and evaluation procedure. Advantages and disadvantages of digital systems, Evolution of Digital technology terminologies used in digital systems.	T1:1.1 R1:8.1 T1:2.9
2	Number system	Binary numbers, two's and one's compliment, addition and subtraction of binary numbers, octal and hexadecimal numbers, binary codes	T1:1.2-1.9
3-4	Boolean algebra and logic gates	Boolean functions, canonical forms, logic gates.	T1: 2.1-2.8
5 -6	Simplification of Boolean functions	K-Maps (4,5 variables),	T1: 3.1- 3.8
7	Simplification of Boolean functions	QM Method	T1: 3.10
8	Simplification of Boolean functions	Mutli-level and Multi-output Circuits	R2:7.1-7.7

Course Content

Lect. No.	Learning Objectives	Topics to be covered	Reference to Text Book
10-14	Combinational Logic, Arithmetic circuits	Adders, Subtractors, Multipliers	T1: 4.1 – 4.7
15-20	MSI Components	Comparators, Decoders, Encoders, MUXs, DEMUXs	T1: 4.8 - 4.11
21-24	Sequential Logic	Flip-Flops & Characteristic tables, Latches	T1:5.1 - 5.4
25-30	Clocked Sequential Circuits	Analysis of clocked sequential circuits, state diagram and reduction	T1:5.5, 5.7 & 5.8
31-34	Registers & Counters	Shift registers, Synchronous & Asynchronous counters, clock skew & Clock Jitter	T1:6.1 - 6.5
35-38	Memory and PLDs	RAM, ROM, PLA, PAL	T1:7.1 - 7.7
39-43	Digital Integrated Circuits	RTL, DTL,TTL,ECL & CMOS Gates, Implementation of Simple CMOS circuits	T1:10.1 -10.7

Evaluation

Component	Duration	Weightage (%)	Date
T1	30 minutes	15 %	10-20 th September
T2	30 minutes	15 %	09-20 th October
T3	30 minutes	15 %	10-20 th November
Regular Lab evaluation	During Lab hours	20 %	Regular Lab days
Final Lab Exam	30 Min	10%	16-21 November
Comprehensive Exam	120 minutes	25%	December 2020
Total		100%	

Introduction to Digital Systems

Binary System:

Two Binary Logic States '0' and '1'

Two voltage levels corresponding to the 2 States

TTL : 0 & 5 V

CMOS 180 nm : 0 & 1.8 V

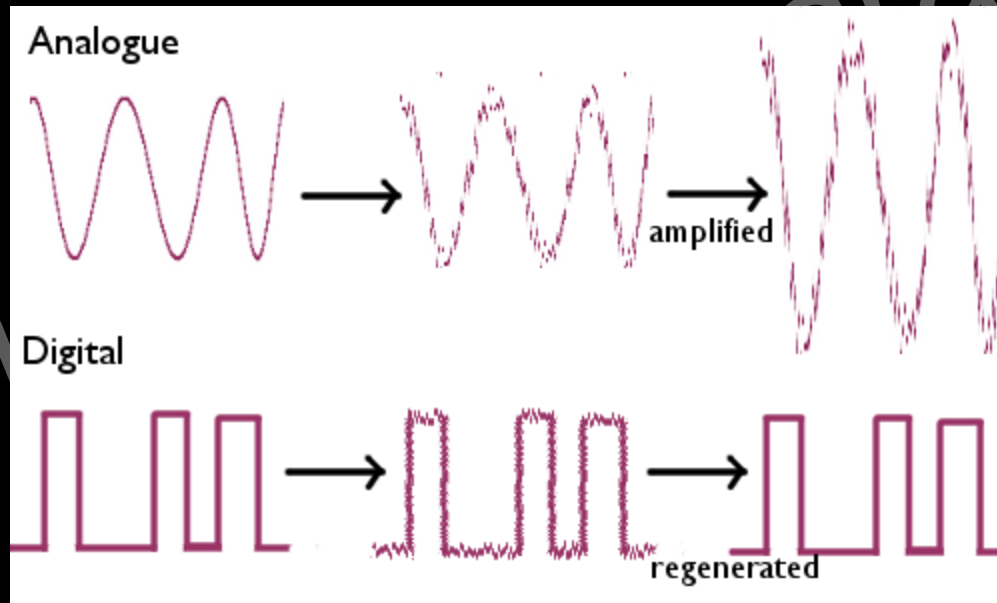
CMOS 45 nm : 0 & 1V

CMOS 7 nm : 0 & 0.8 V

Introduction to Digital Systems

Advantages of Digital System:

1. Negligible Noise



Introduction to Digital Systems

Advantages of Digital System:

2. Computation is easy.

All microprocessors are digital system based.

3. Storage of and retrieval of data is easy.

RAM, Hard Disks all are digital

4. Error detection and Correction possible

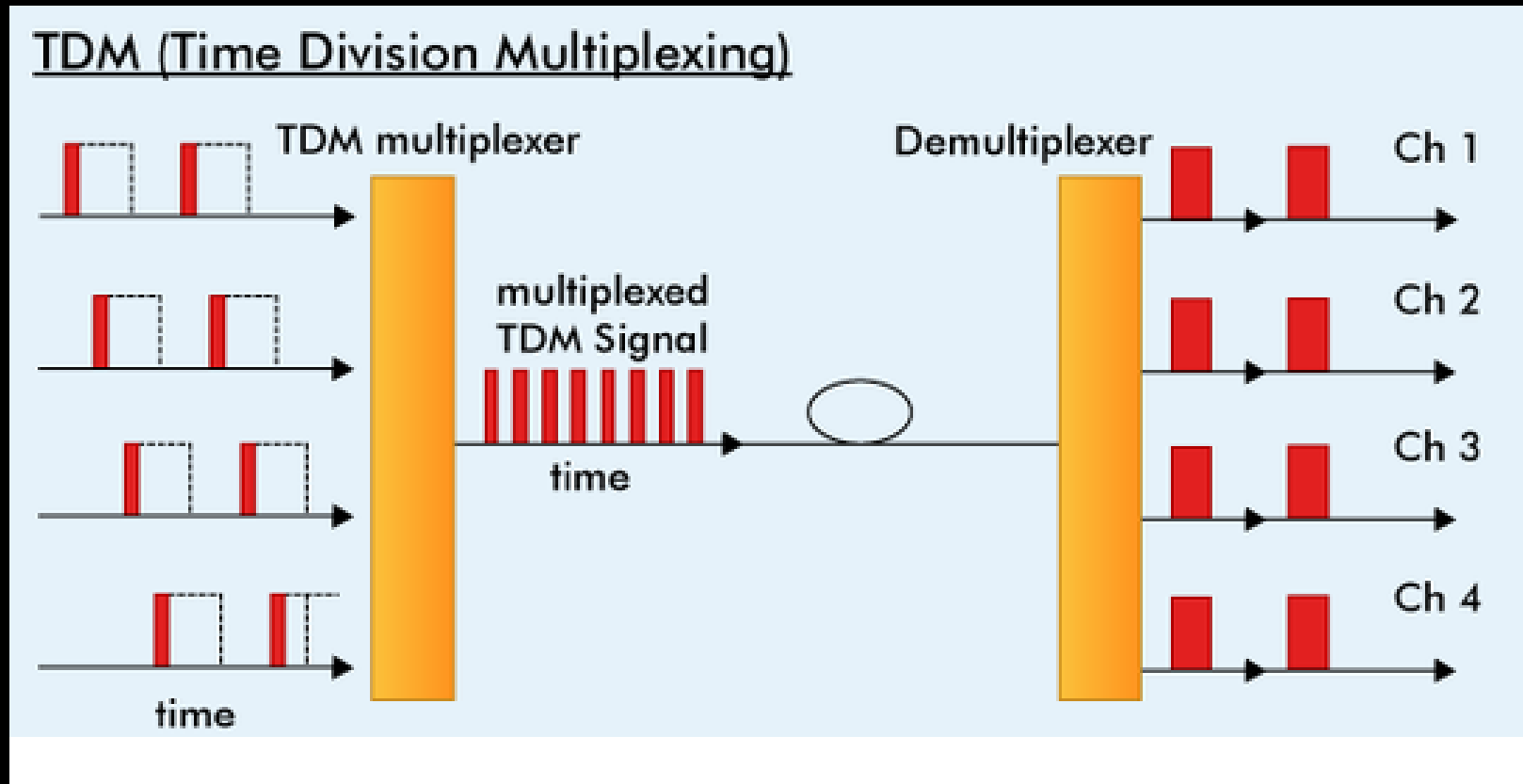
5. Digital signal processing enables wide variety of applications

6. Data encrypting and de- encrypting is very secure

Introduction to Digital Systems

Advantages of Digital System:

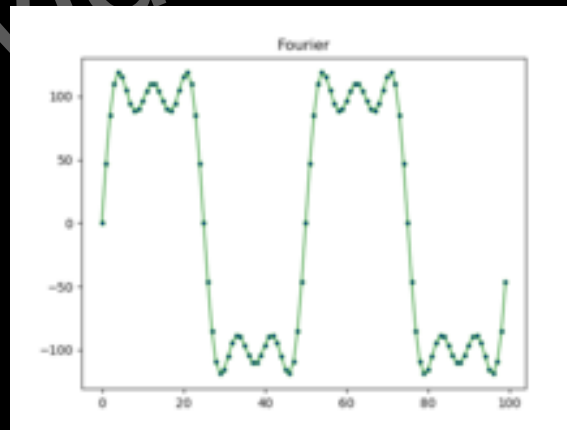
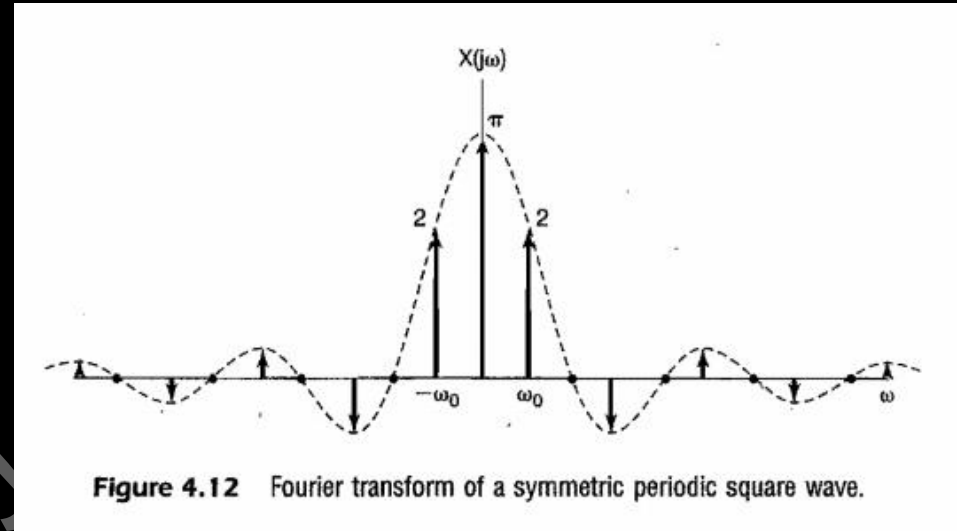
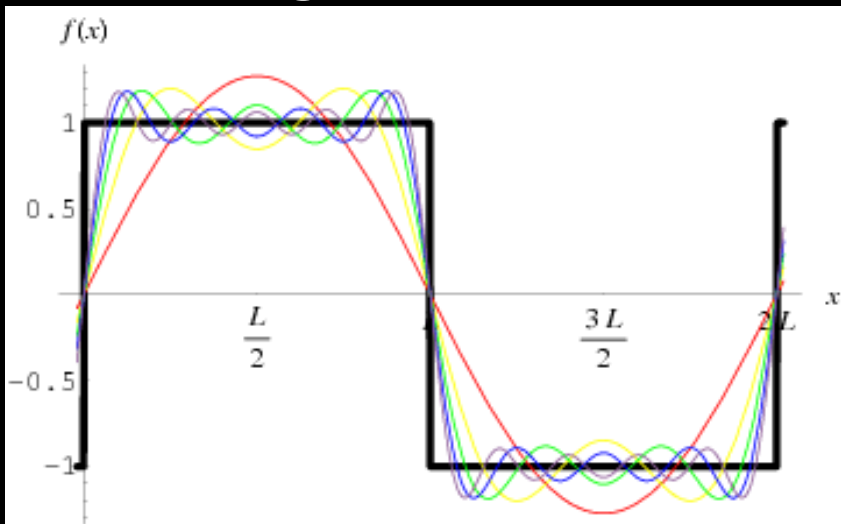
7. Time Division Multiplexing



Introduction to Digital Systems

Disadvantages of Digital System:

1. Large Bandwidth



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Introduction to Digital Systems

Disadvantages of Digital System:

2. Everything in Real world is Analog

ADC and DAC Required

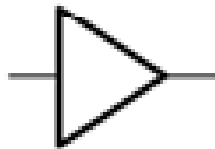
3. Long distance transition by wire/ RF is analog

Modulation of Digital bits required.

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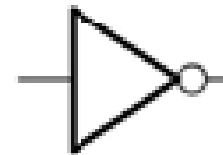
Basic Binary Logic Gates

YES



INPUT	OUTPUT
A	
0	0
1	1

NOT



INPUT	OUTPUT
A	
0	1
1	0

Basic Binary Logic Gates

AND



INPUT		OUTPUT
A	B	
0	0	0
1	0	0
0	1	0
1	1	1

OR



INPUT		OUTPUT
A	B	
0	0	0
1	0	1
0	1	1
1	1	1

XOR



INPUT		OUTPUT
A	B	
0	0	0
1	0	1
0	1	1
1	1	0

Basic Binary Logic Gates

NAND



INPUT		OUTPUT
A	B	
0	0	1
1	0	1
0	1	1
1	1	0

NOR



INPUT		OUTPUT
A	B	
0	0	1
1	0	0
0	1	0
1	1	0

XNOR



INPUT		OUTPUT
A	B	
0	0	1
1	0	0
0	1	0
1	1	1

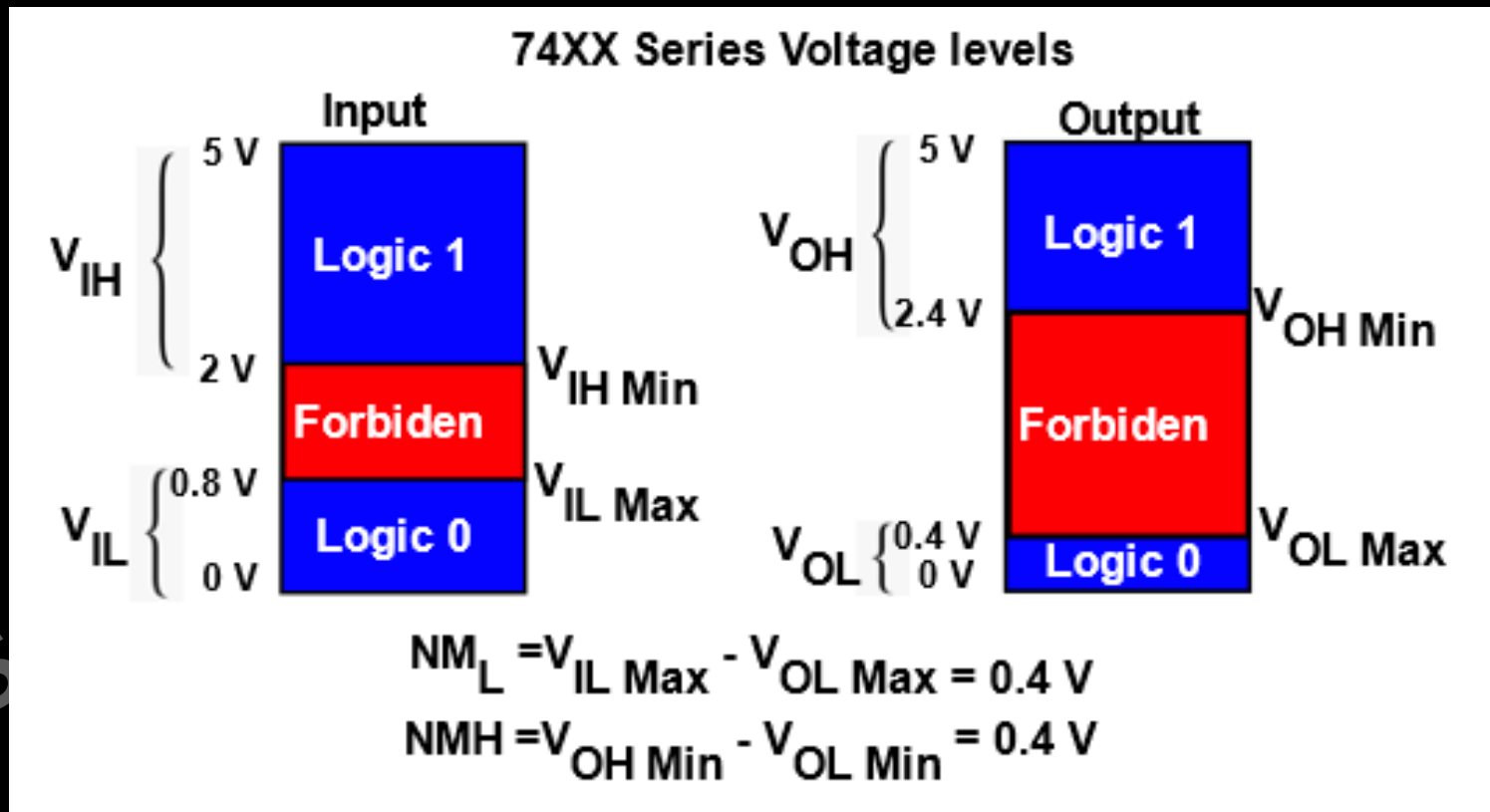
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Evolution of Digital Technology

- **Diode Transistor Logic** : **1959**
- **Resistor Transistor Logic** : **1961**
- **Transistor Transistor Logic** : **1963 Discrete IC**
- **Emitter-coupled logic** : **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.

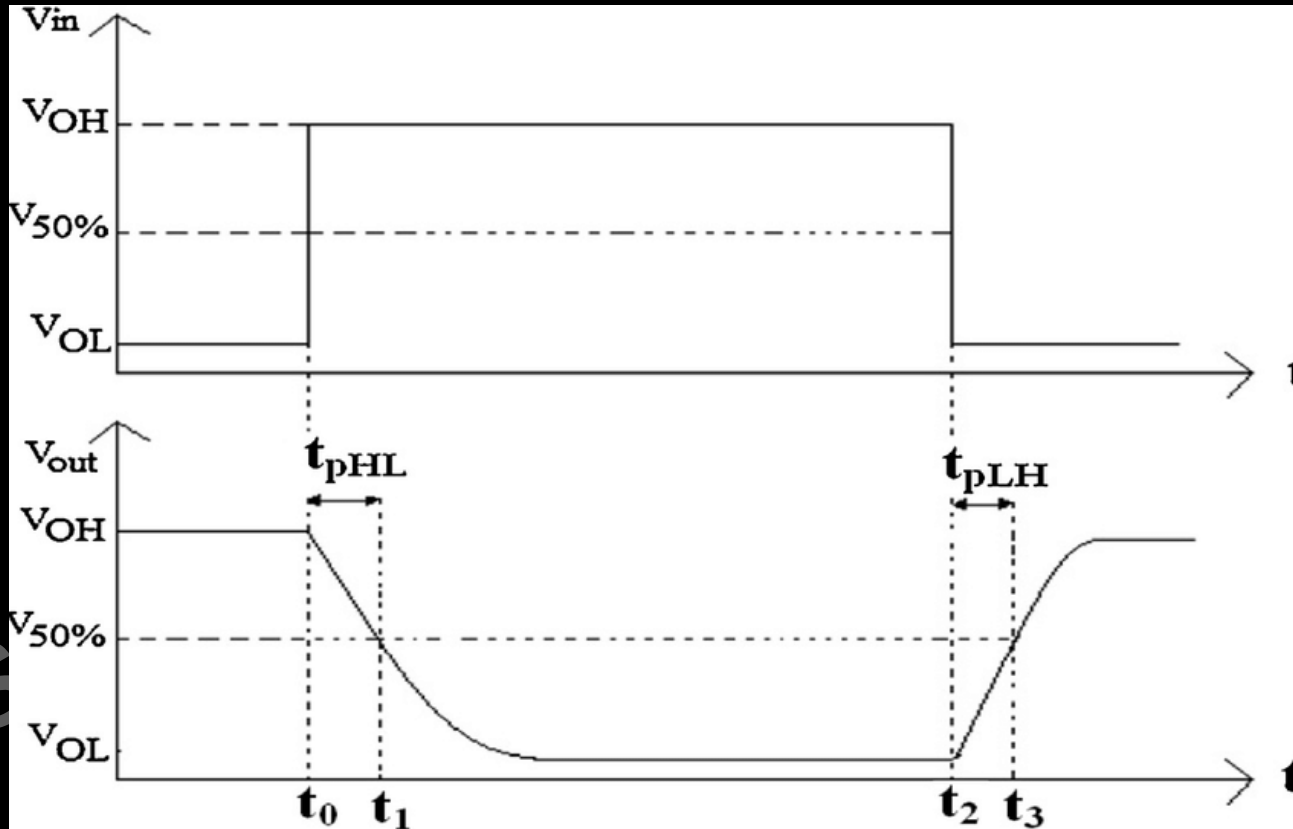
Common Terminologies of Digital System

1. Noise Margin



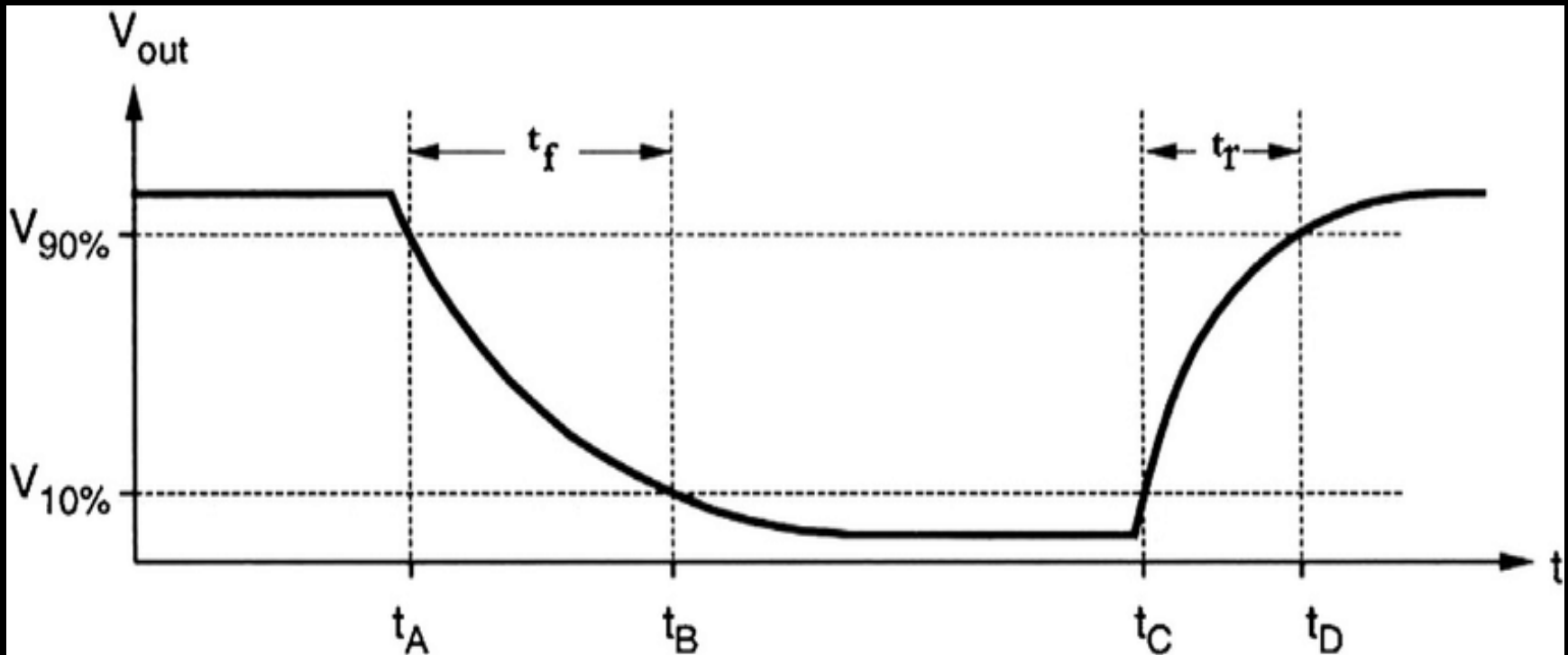
Common Terminologies of Digital System

2. Propagation Delay (Eg. Inverter)



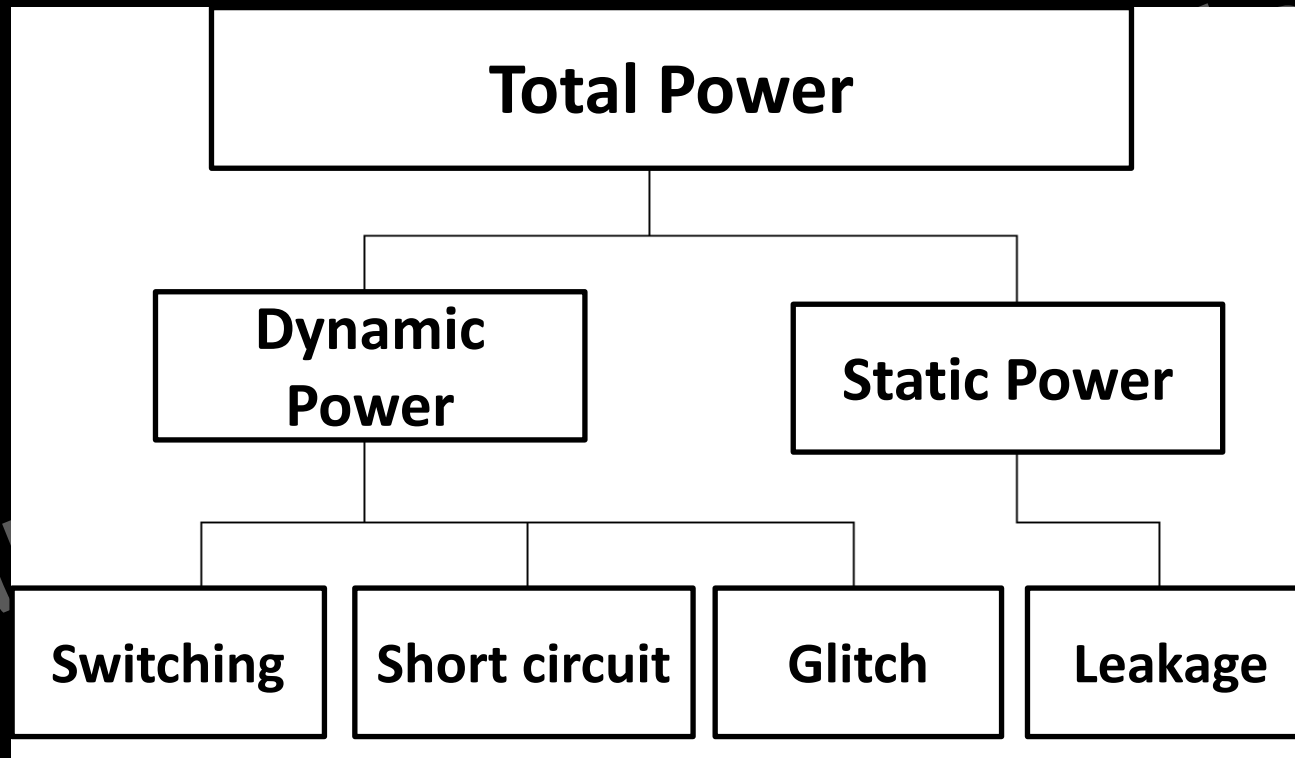
Common Terminologies of Digital System

3. Rise Time and Fall Time



Common Terminologies of Digital System

4. Power



Thank You

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