Digital Design

Instructor's Name: Sanjay Vidhyadharan (L1)
Ankur Bhattacharjee (L2)

Online Mode
Google Class Code: pdkrzzi

Birla Institute of Technology & Science, Pilani
Hyderabad Campus

18-Aug-20

1

Innovate   achieve   lead

Salient Features of Online Mode of Classes

➢ **Lecture Classes**

    ➢ **As per timetable through google meet.**

    ➢ **Presentations will be uploaded in**
        PDF format.

    ➢ **https://sanjayvidhyadharan.in/Downloads**
        Study Materials for Digital Design 2020

    ➢ **https://sanjayvidhyadharan.in/blog/digital-elctronics-design/**

Salient Features of Online Mode of Classes

➢ **Tut classes**

    ➢ **As per timetable through google meet**

    ➢ **New Tut Questions will be uploaded weekly basis on CMS**

    ➢ **Students should attempt to do problems themselves**

    ➢ **Solutions will be discussed in Tut classes**

    ➢ **https://sanjayvidhyadharan.in/Downloads**

        Study Materials for Digital Design 2020

Salient Features of Online Mode of Classes

➢ **Lab classes**
   - ➢ **As per timetable through google meet.**
   - ➢ **New Lab Assignment will be uploaded every Monday on Link provided on CMS.**
   - ➢ **Students should carryout lab experiments themselves within a week.**
   - ➢ **Experiments done will be evaluated in Lab classes subsequent week.**
   - ➢ **Upload exp files as directed by Lab instructor.**

Salient Features of Online Mode of Classes

Notices : On CMS & Google Classroom pdkrzzi

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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 %	10-20th September
T2	30 minutes	15 %	09-20th October
T3	30 minutes	15 %	10-20th 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
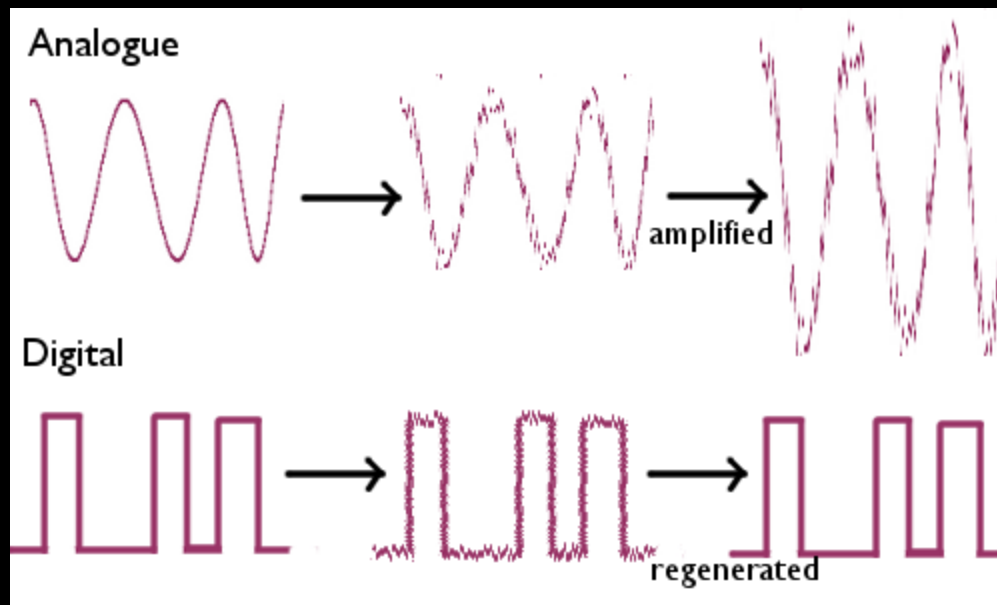
Introduction to Digital Systems

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

TDM (Time Division Multiplexing)
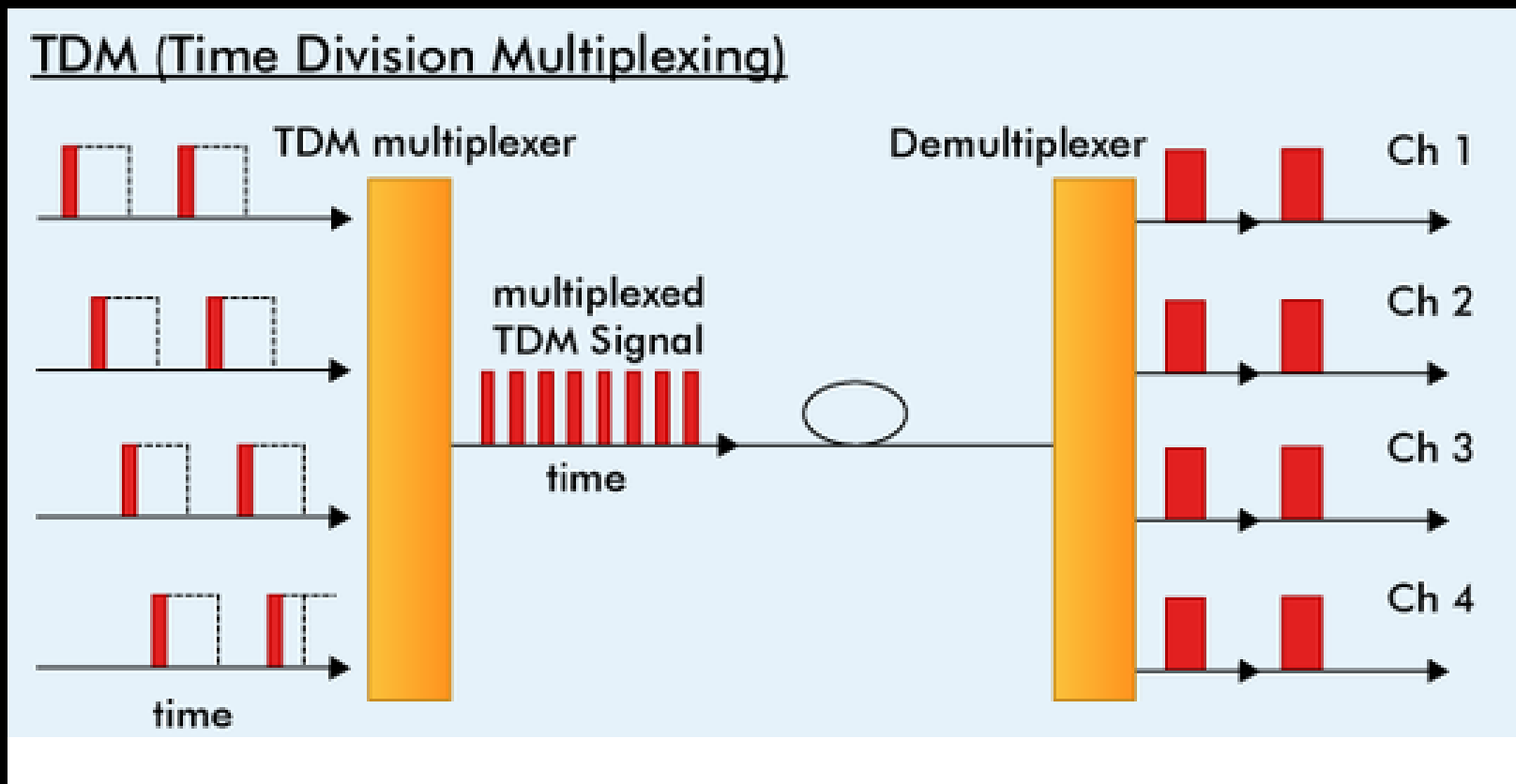
Introduction to Digital Systems

Disadvantages of Digital System:
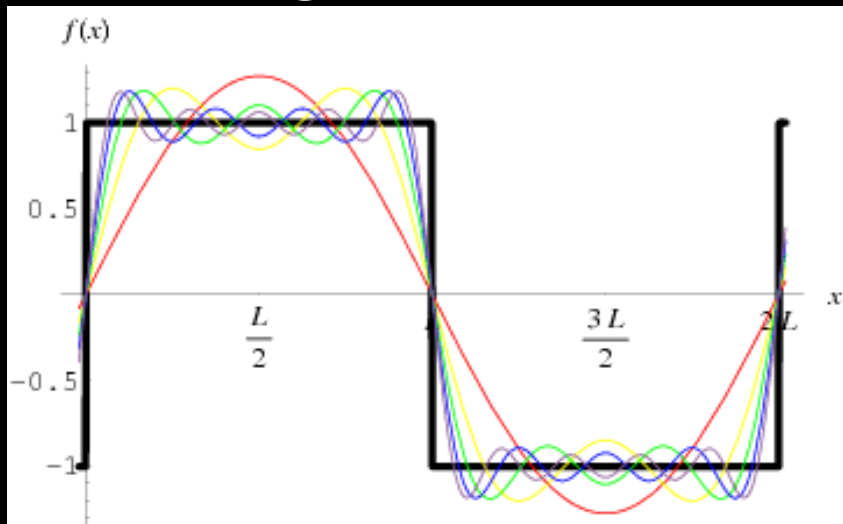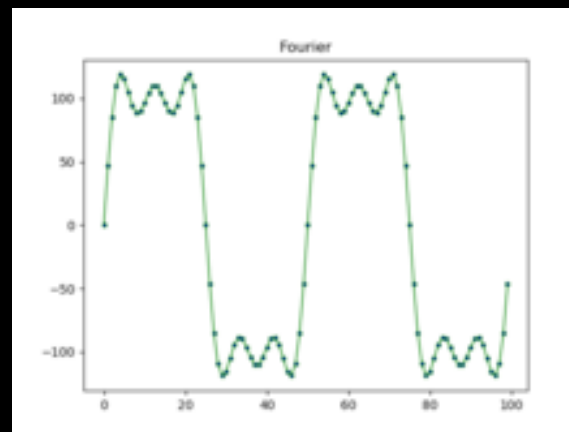
1. Large Bandwidth
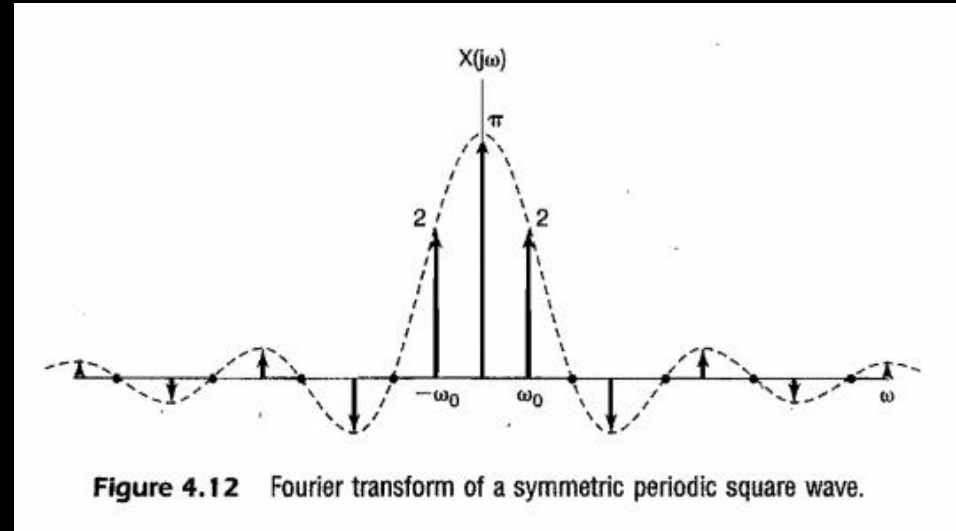
Figure 4.12   Fourier transform of a symmetric periodic square wave.

Introduction to Digital Systems

Disadvantages of Digital System:

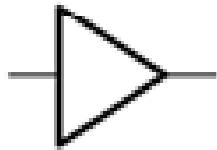2. Everything in Real world is Analog
       ADC and DAC Required

3. Long distance transition by wire/ RF is analog
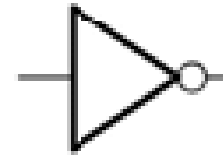   Modulation of Digital bits required.

Basic Binary Logic Gates
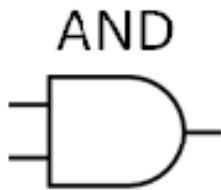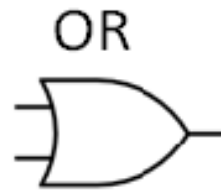
YES

NOT

INPUT	OUTPUT
A	
0	0
1	1

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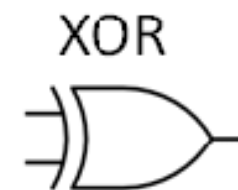
INPUT		OUTPUT
A	B	
0	0	0
1	0	1
0	1	1
1	1	0

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

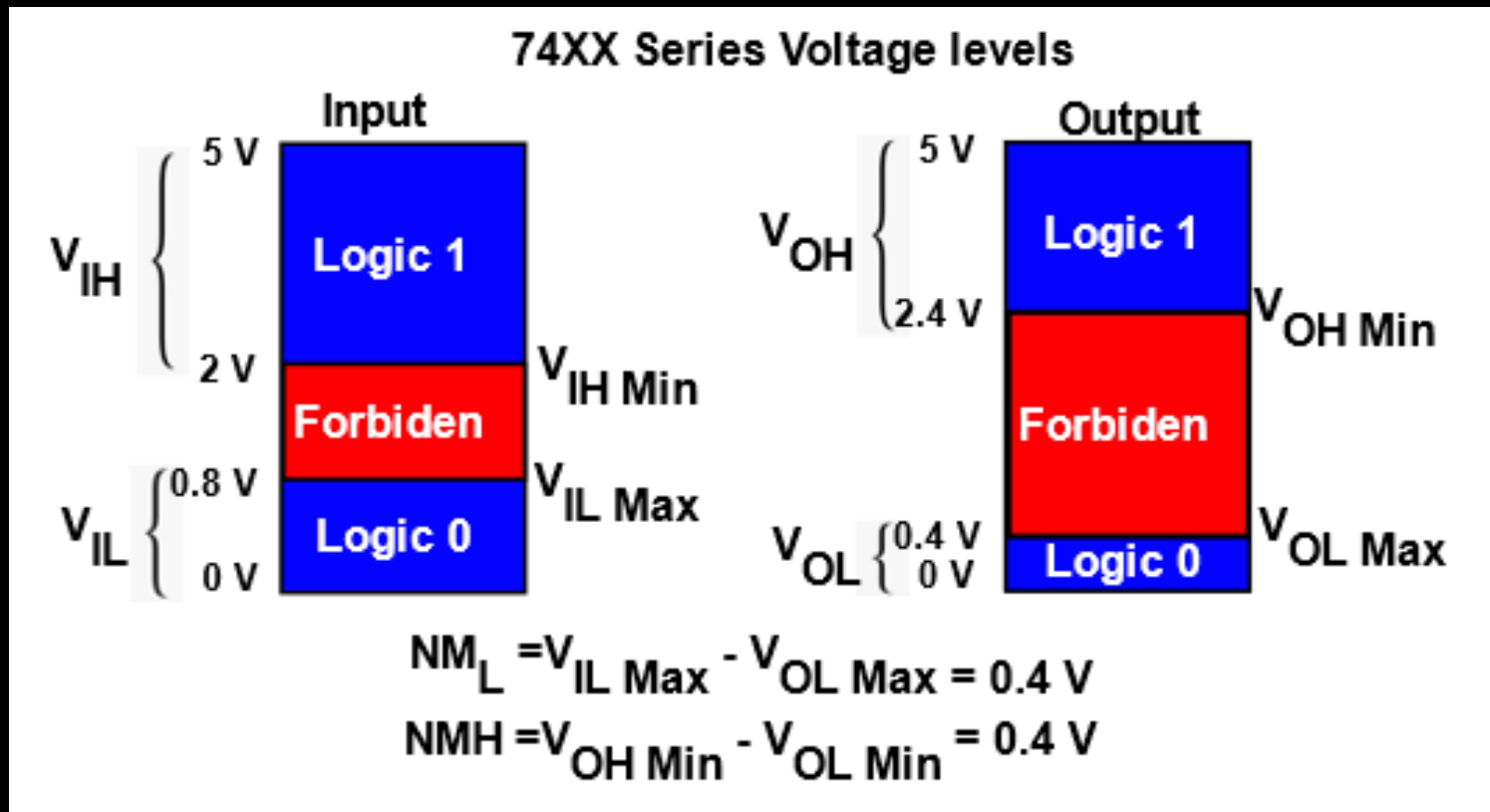| INPUT		OUTPUT
A	B	
0	0	1
1	0	0
0	1	0
1	1	1

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.
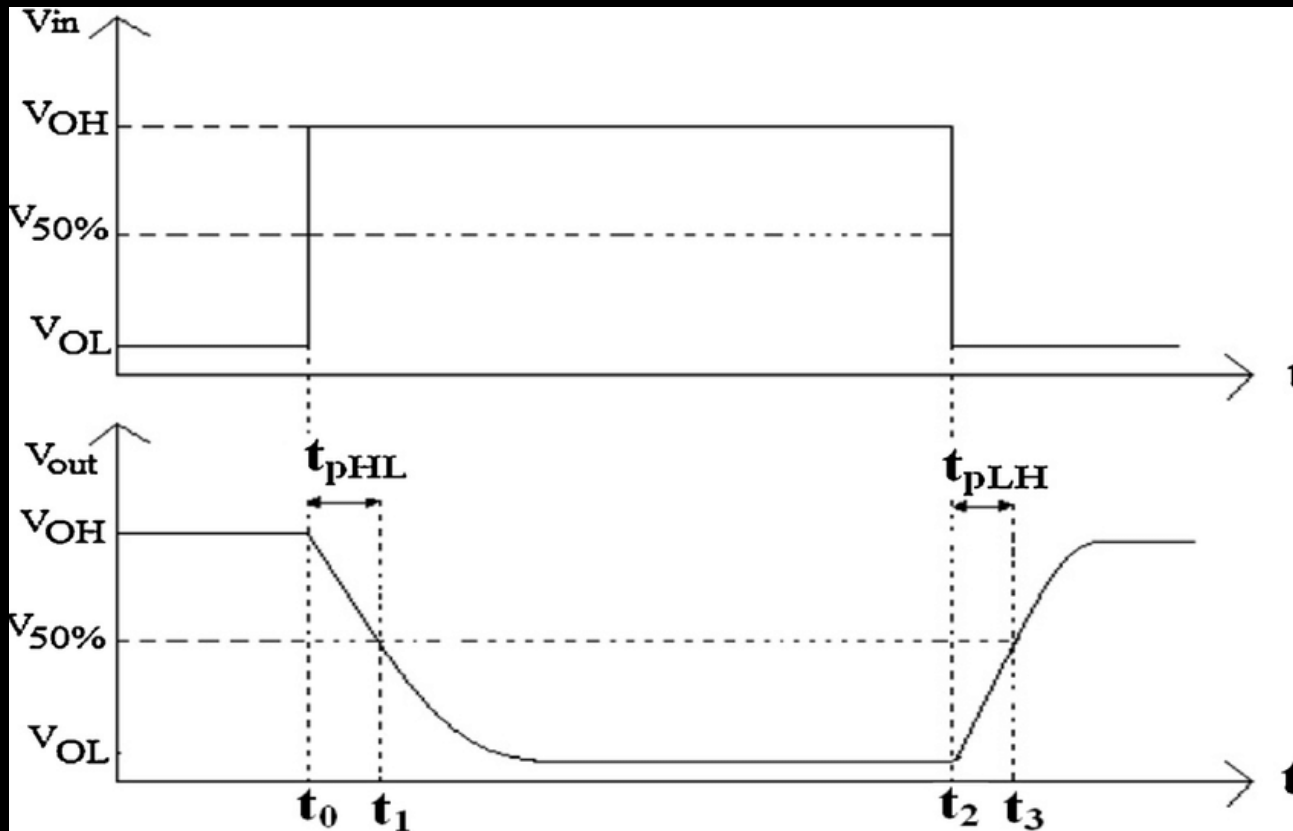
Common Terminologies of Digital System

1. Noise Margin

74XX Series Voltage levels

Input

- 5 V
- V_{IH} { 2 V : Logic 1 — $V_{IH\ Min}$
- Forbiden
- V_{IL} { 0.8 V, 0 V : Logic 0 — $V_{IL\ Max}$

Output

- 5 V
- V_{OH} { 2.4 V : Logic 1 — $V_{OH\ Min}$
- Forbiden
- V_{OL} { 0.4 V, 0 V : Logic 0 — $V_{OL\ Max}$

$$NM_L = V_{IL\ Max} - V_{OL\ Max} = 0.4\ V$$
$$NMH = V_{OH\ Min} - V_{OL\ Min} = 0.4\ V$$

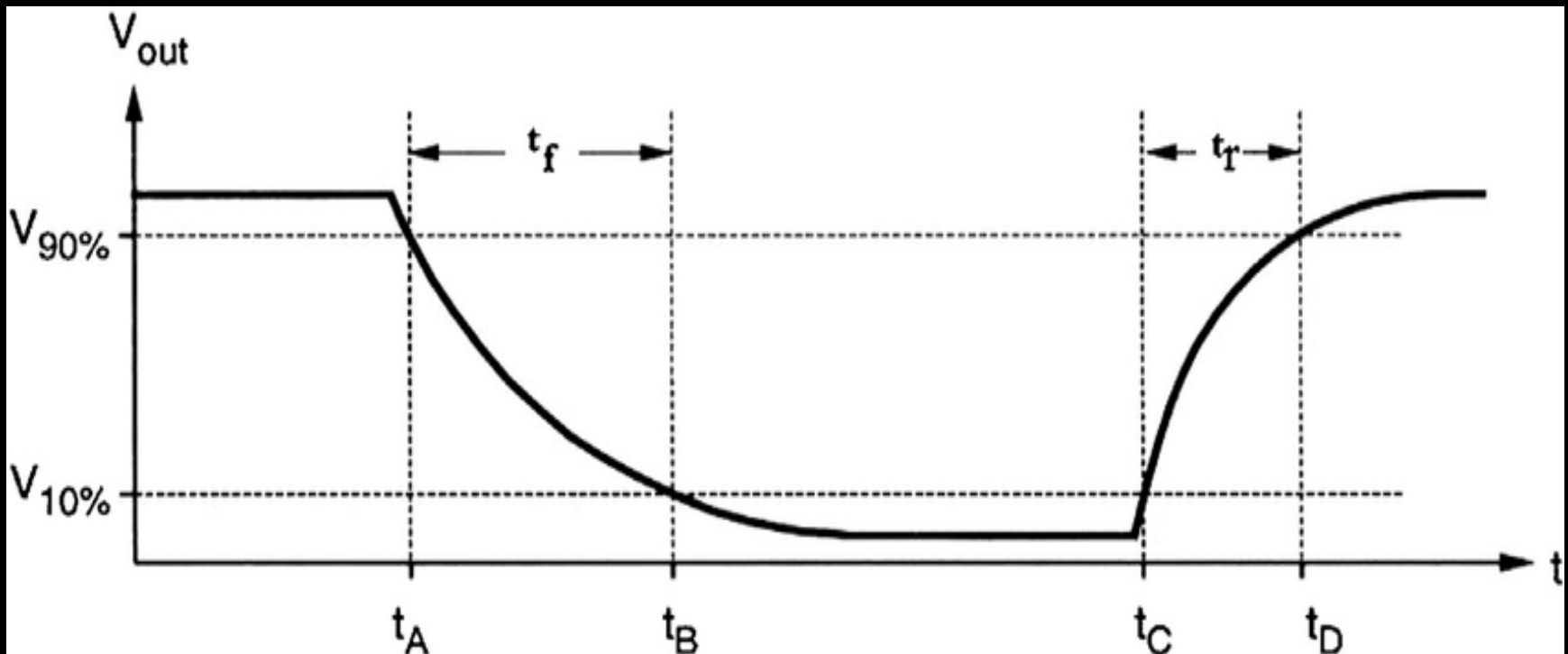# Common Terminologies of Digital System

2. Propagation Delay (Eg. Inverter)
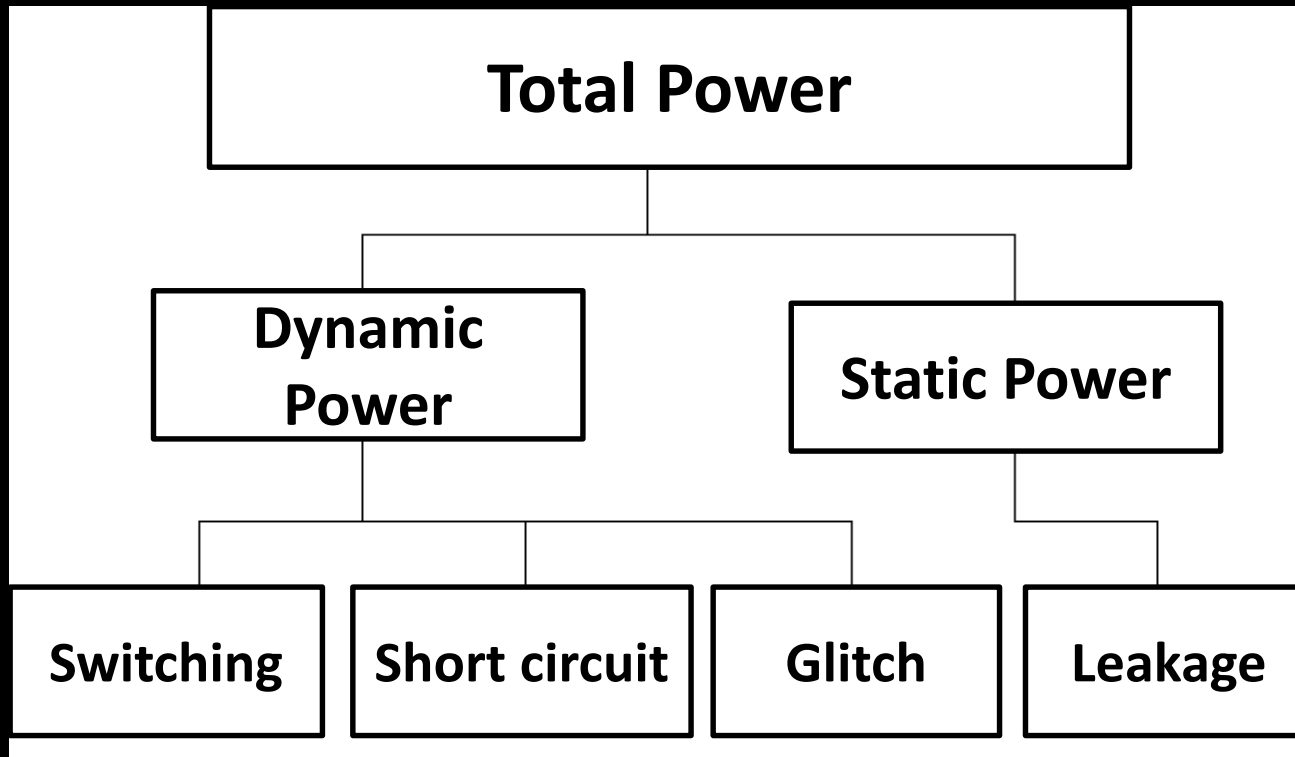
Common Terminologies of Digital System

3. Rise Time and Fall Time

Common Terminologies of Digital System

4. Power

Total Power

Dynamic Power

Static Power

Switching

Short circuit

Glitch

Leakage

Thank You