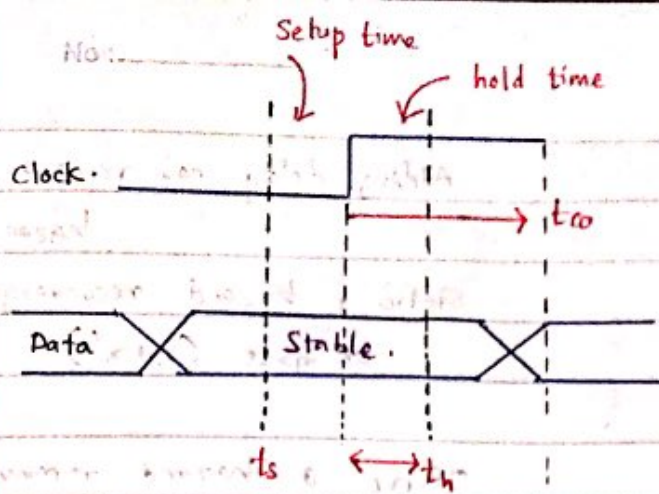


No. \_\_\_\_\_

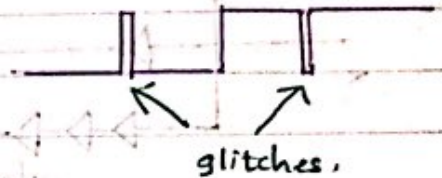
Date: \_\_\_\_\_



13/09/17

Lecture 05Timing Hazards

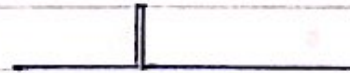
- \* A glitch is a spike which is usually unwanted.
- \* A hazard are the unwanted glitches appeared in data transmission.
- \* this occurs when the propagation delays are unbalanced.
- \* Hazards ~~may~~ appears in combinational ccts; not in sequential ccts.
- \* There won't be any problem <sup>even</sup> if data get changed until the time when the sampling is done. (But not after that).

Classification of Hazards:

done by the glitch they may produce.

## 01. Static Zero hazard;

- Signal is static at zero, glitch arises.



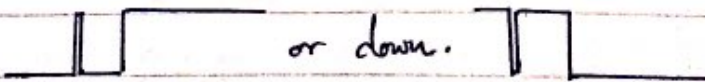
## 02. Static one hazard.

- Signal is static at one, glitch falls.



## 03. Dynamic Hazard.

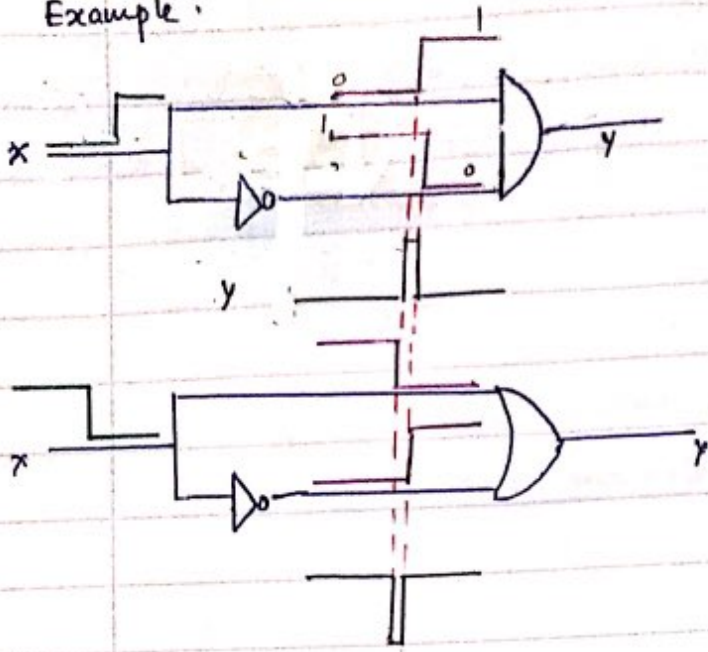
- Signal is changing up or down.



No. \_\_\_\_\_

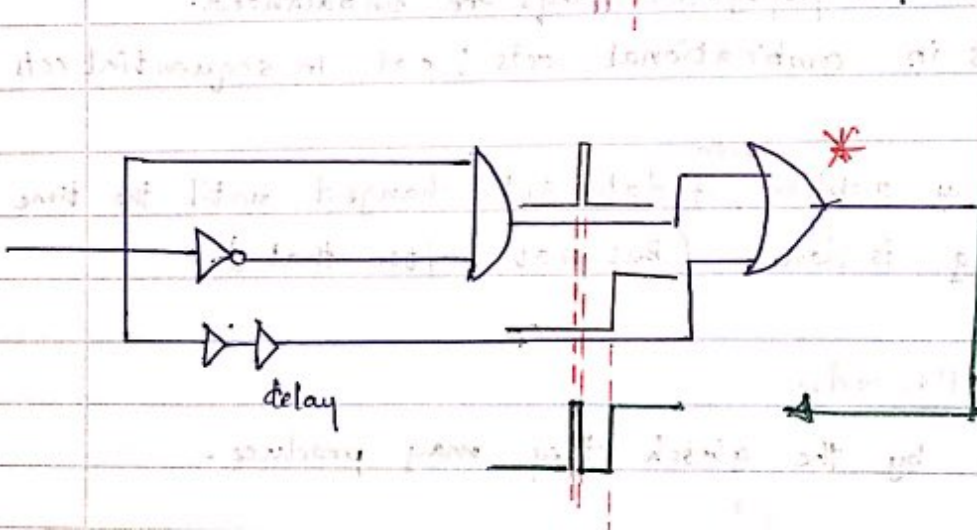
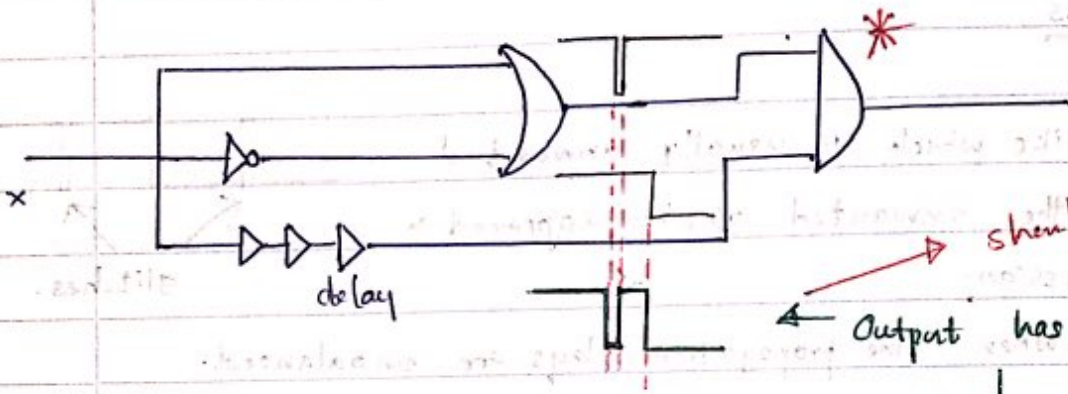
Date. \_\_\_\_/\_\_\_\_/\_\_\_\_

Example.



Adding delay can remove hazards  
Static 1 hazard reconverges at  
OR Gate ( $x+x'$ )

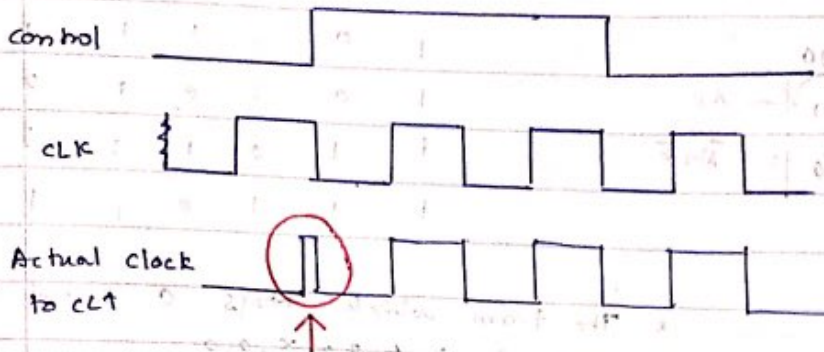
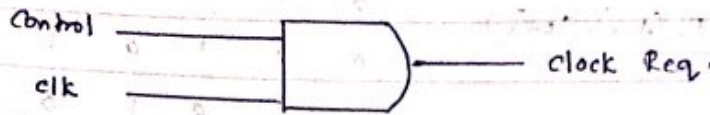
Static 0 hazard reconverges at  
AND Gate ( $x \cdot x'$ )



Problem!  
Even the delaying is  
added, we have  
used the wrong  
gate.



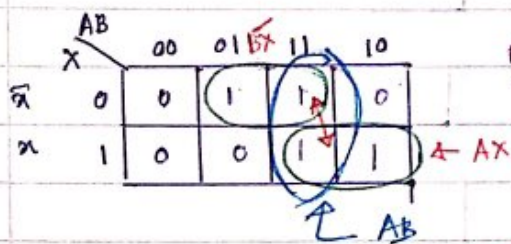
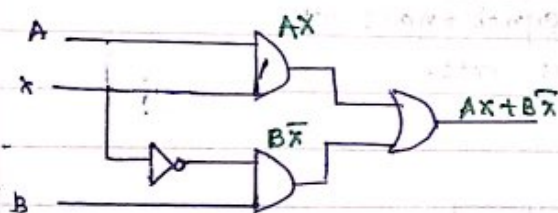
## Glitches in clock Gating Module.



\* To avoid glitches, the control signal should start at exactly Logic zero of the clock. Otherwise the clock pulse width will be violated.

\* Control signal should end also at when clock is zero.

## Hazards on a Karnaugh Map.



$$F = AX + B\bar{x}$$

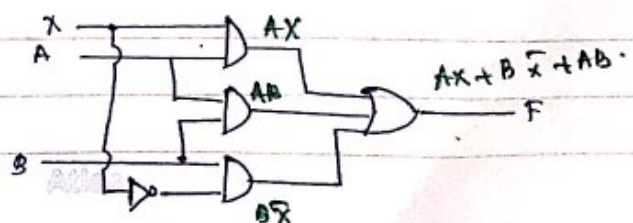
Hazards are shown by  $\leftrightarrow$

\* Hazard appear when  $A=B$ ,  $B=1$

This has redundant term  $AB$  added

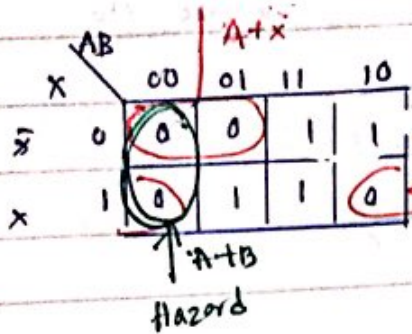
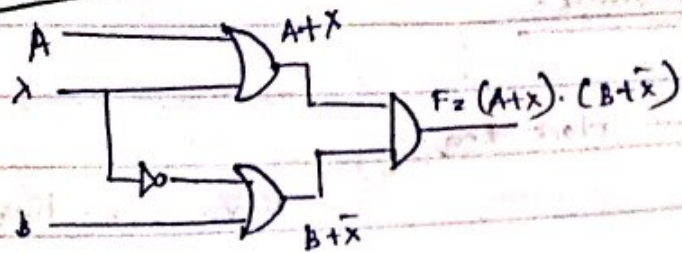
$$F = AX + B\bar{x} + AB$$

This fills the valley  
betw<sup>n</sup> term  $AX$  &  $B\bar{x}$





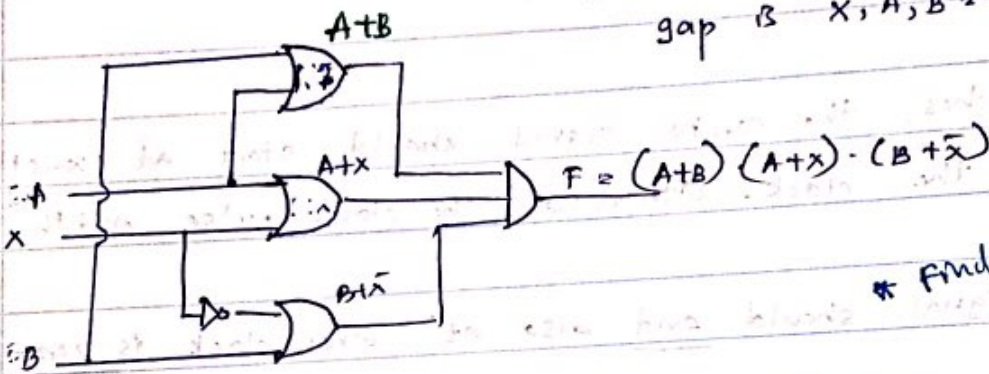
Static  
Zero Haz



Date: / /

A	B	x	$\bar{x}$	$A+x$	$B+\bar{x}$	F
0	0	0	1	0	1	0
0	0	1	0	1	0	0
0	1	0	1	0	1	0
0	1	1	0	1	1	1
1	0	0	1	1	1	1
1	0	1	0	1	0	0
1	1	0	1	1	1	1
1	1	1	0	1	1	1

\* The term which stays 0 across the gap is  $x, A, B = x, 0, 0 \Rightarrow A+B$ .



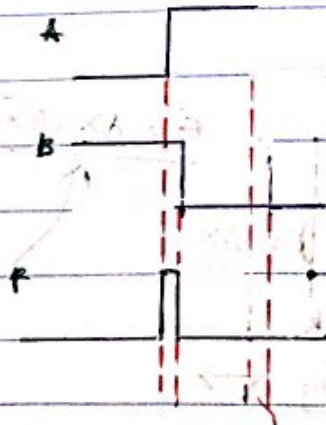
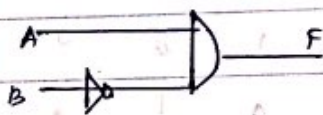
\* Find a connection between two groups  
→ hazard

• Hazards with multiple input changes.

\* Hazards do not hurt synchronous cts.

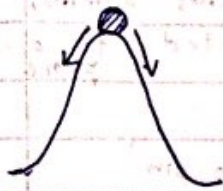
But kill asynchronous cts.

ex:- AND gate.





## Stability :



## Meta Stability

— A stable state of a dynamic system other than the system's state of least energy.

## Metastability in Electronics.

Ability of a digital electronic system to persist for an unbounded time in an unstable equilibrium (metastable state)

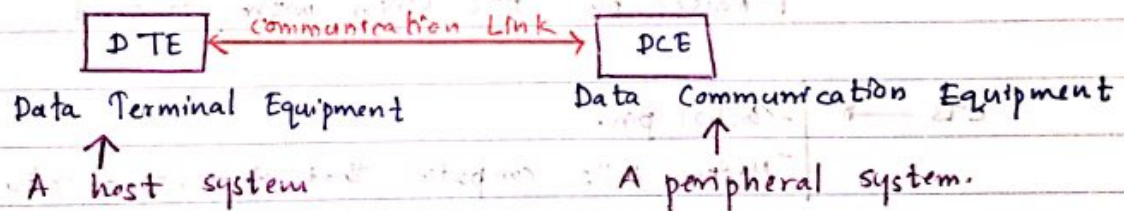
cct can act in unpredictable ways leading to glitches / failures.

As a result

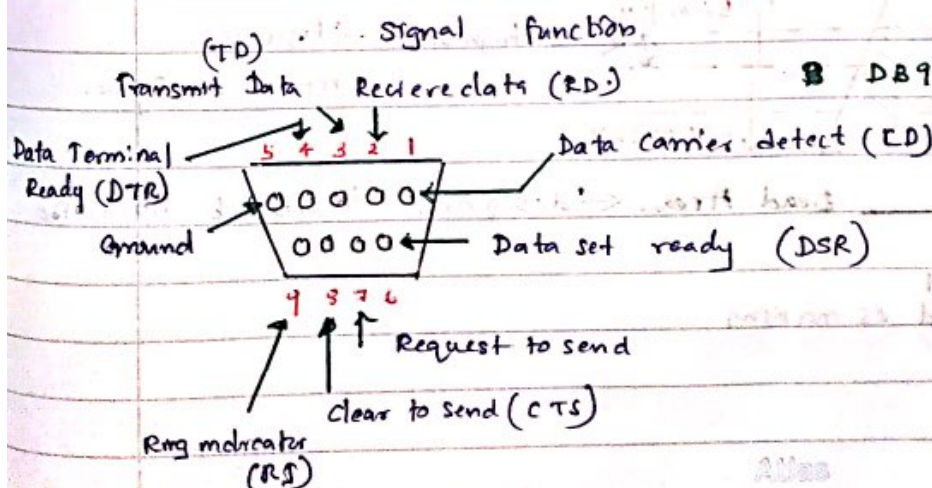
cct may be unstable to settle into a stable '0' or '1' within the time required for proper cct operation.

## RS 232 Communication Link. → Recommended standard 232.

- \* devices connect to serial port for the ease of debugging, cost effective, etc.
- \* Serial port is known as COM port (communication)
- \* RS 232 is related to serial Data communication between DTE & PCE

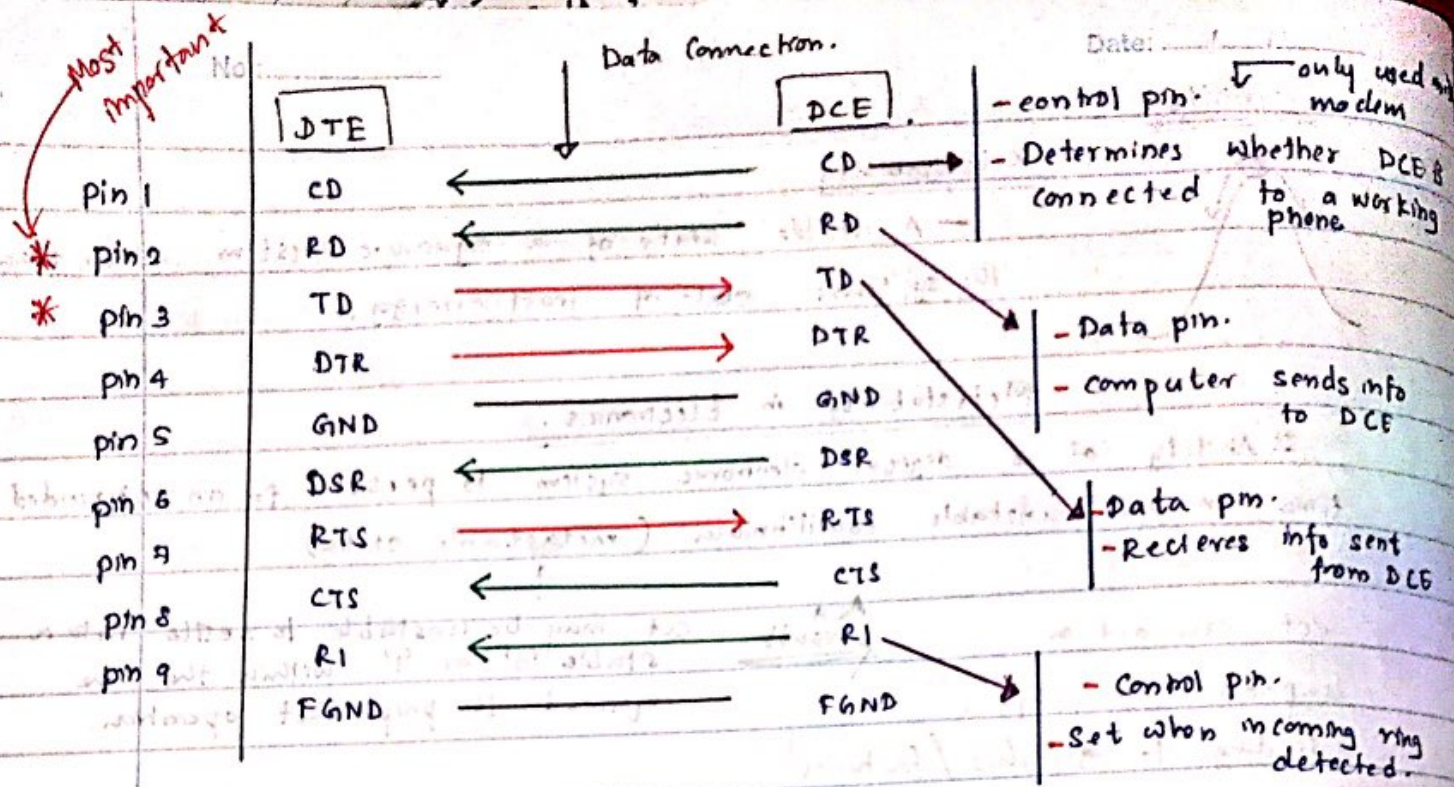


- \* RS 232 is a complete serial communication protocol
- Specifies, Signal voltages, pin wiring, Signal timing, mechanical connection



DB9 connector is the most popular connector.



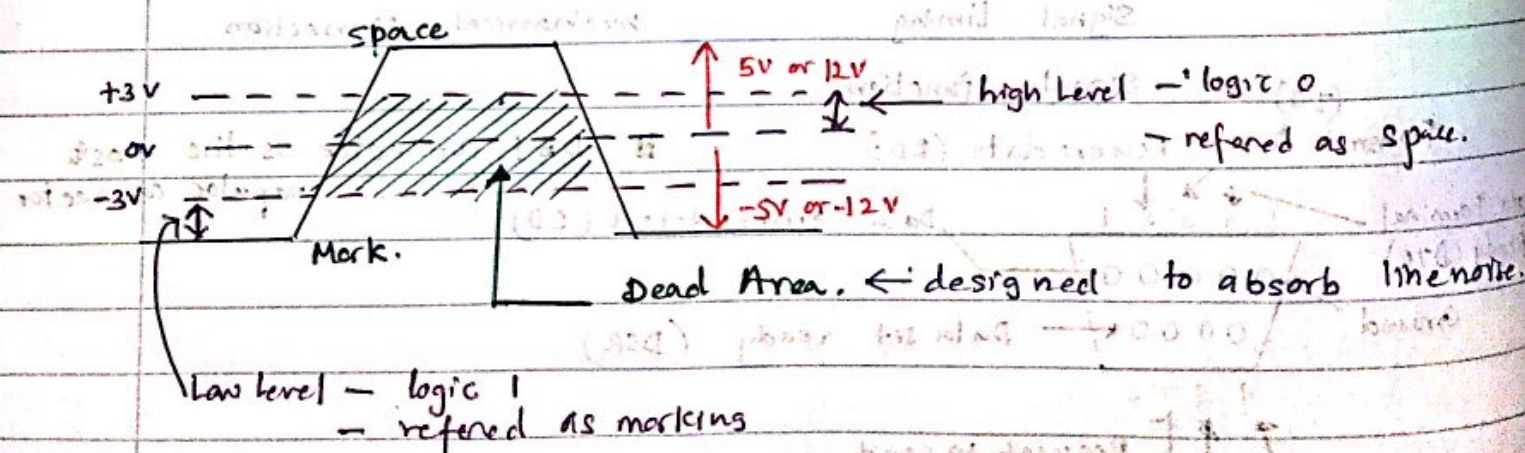


**DTR** → - Control pin.  
- computer tells the DCE that it is ready to communicate.  
Raised by DTE when powered on

**DSR** → - control pin.  
- computer ask modem if it can send info.  
- Raised by DTE when wishes to send.

**CTS** → - Control pin.  
- Modem tells computer that it can send info

**\* Every pin must be connected**  
If not using make it connected to somewhere?





Most devices use three wires

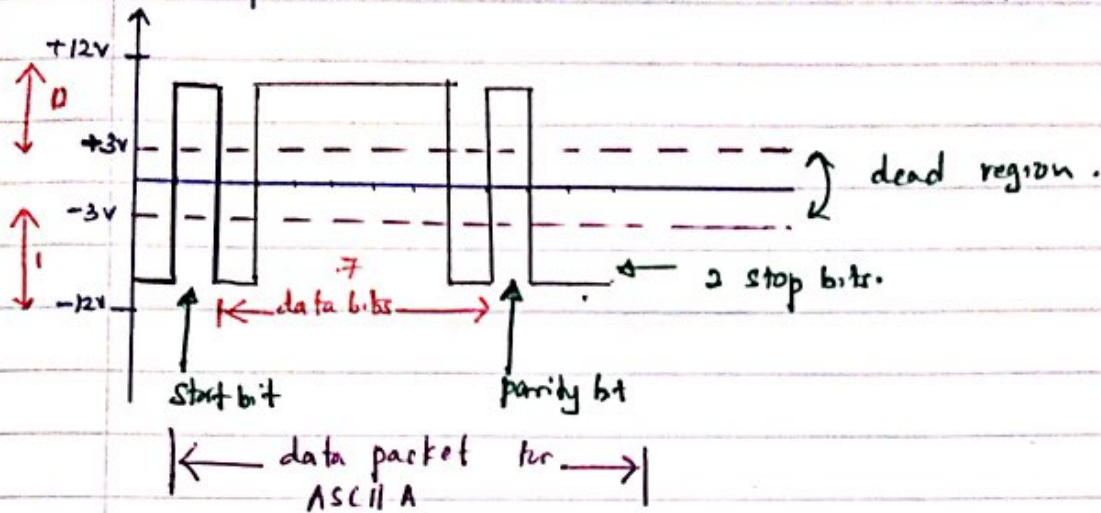
Transmit data

Receive data

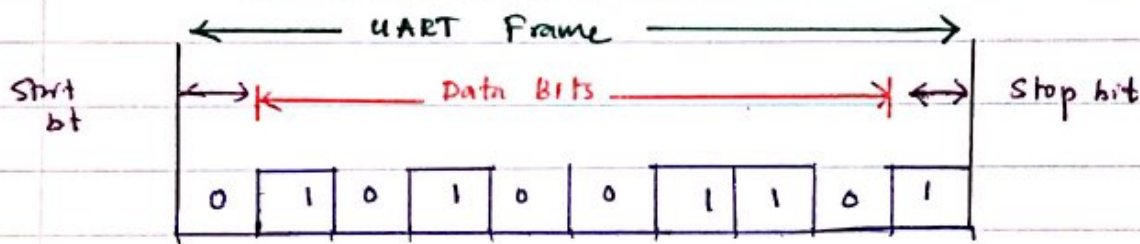
Signal Ground

- \* no hardware flow control signal.

- ♥ simplifies the hardware connections & software design.



## 2) Universal Asynchronous Receiver / Transmitter (UART)

T<sub>x</sub> $R_x$ 

- a) 1 START bit
- b) 5/6/7/8 data bits
- c) 1 parity bit (opt)
- d) 1/1.5/2 stop bits

- 1 START bit
- 5/6/7/8 data bits
- 1 parity (opt)
- 1 stop bit

\* When connecting 2 devices, where clock speed are different the receiving device has to sample data in the same speed the sender does.

→ use clock recovering.