

## Chapter 4 - MOS Inverter - Intro and Definitions

Inverter symbol



### Types of inverters

1) Static

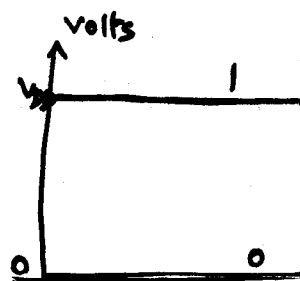
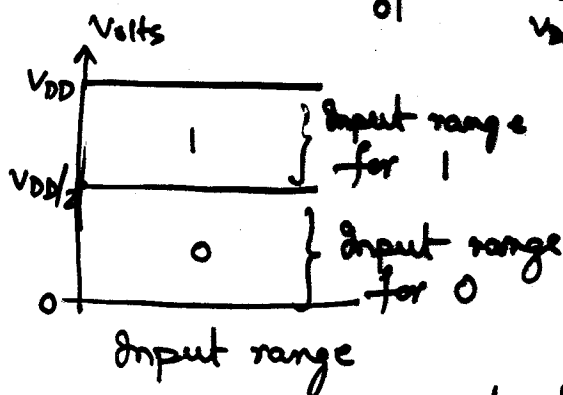
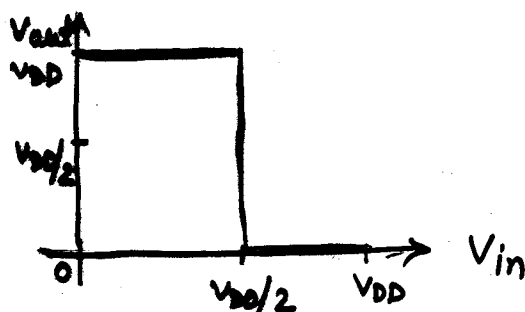
- All nodes have a DC path to ground or  $V_{DD}$
- If clocks are used, they are applied to the logic inputs

2) Dynamic

- Requires periodic clocks synchronized with data signals.
- Clocks are applied to the load elements and to transfer gates.

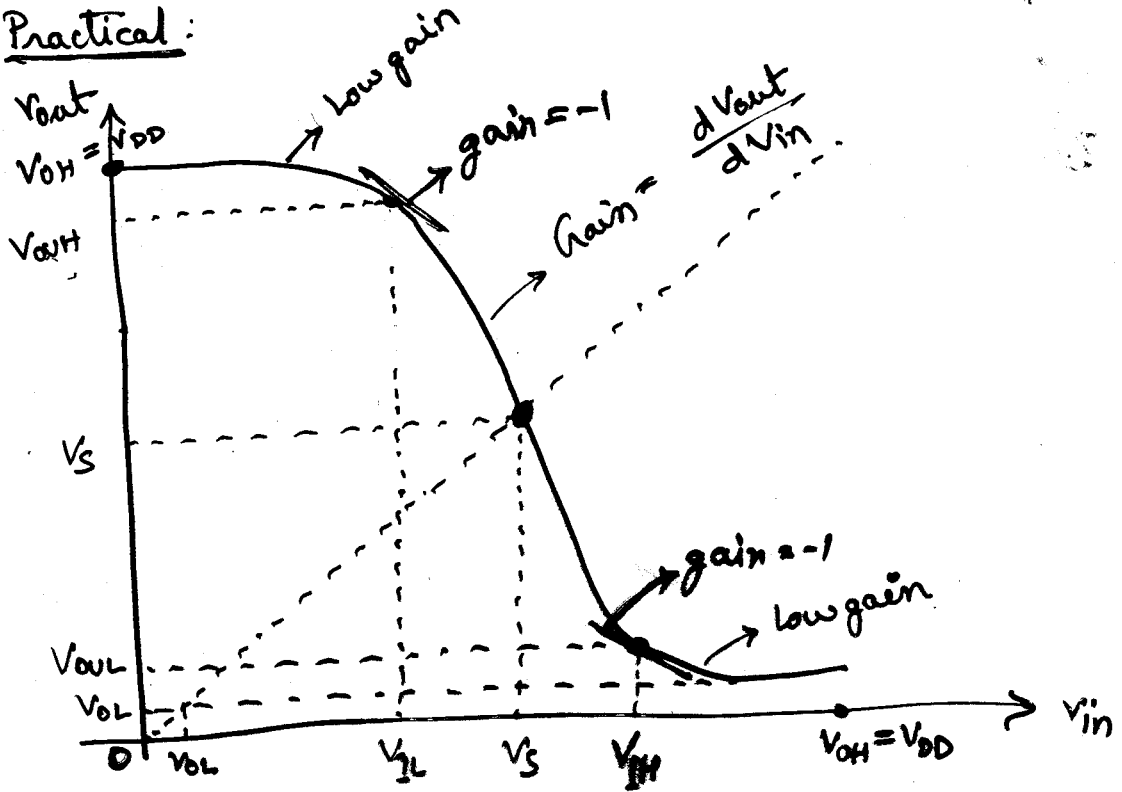
### Voltage Transfer characteristics

Ideal:

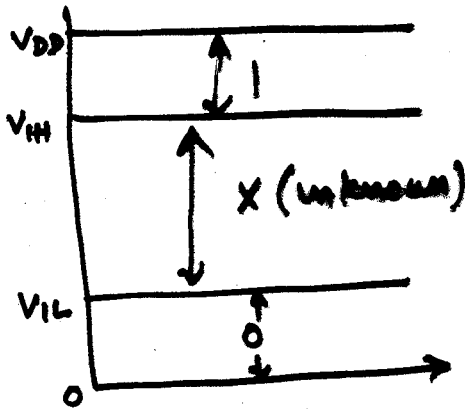


Output range < Input range

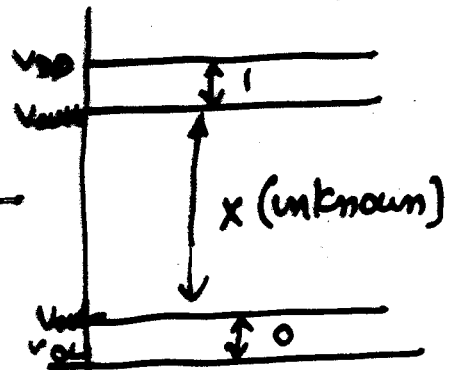
Practical:



Input range



output range

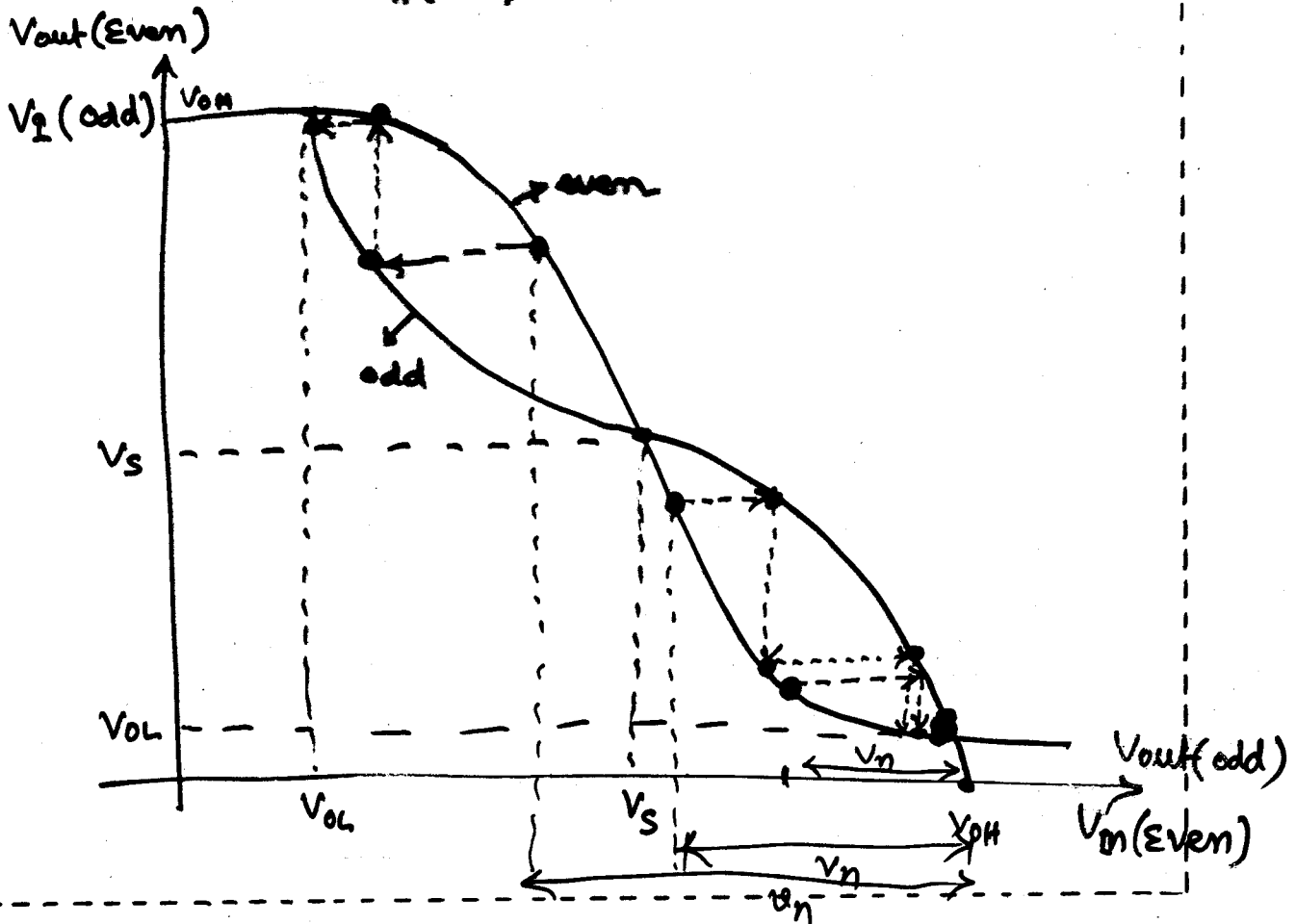
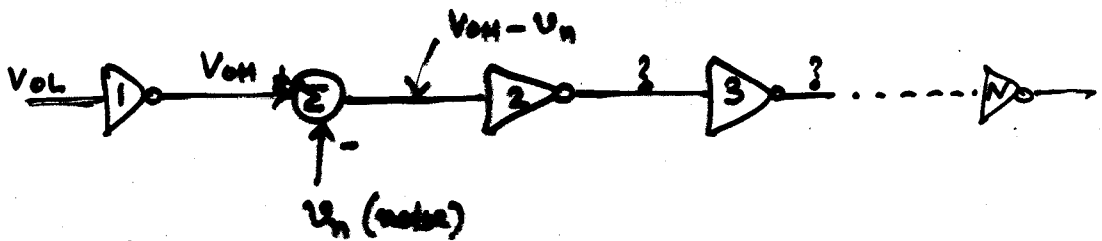


Noise Margin Definitions

Noise  $\rightarrow$  unwanted signal (voltage or current) at the logic nodes.

Noise Margin (NM)  $\rightarrow$  Largest magnitude of noise at the input that will be attenuated as it passes from the input to output.

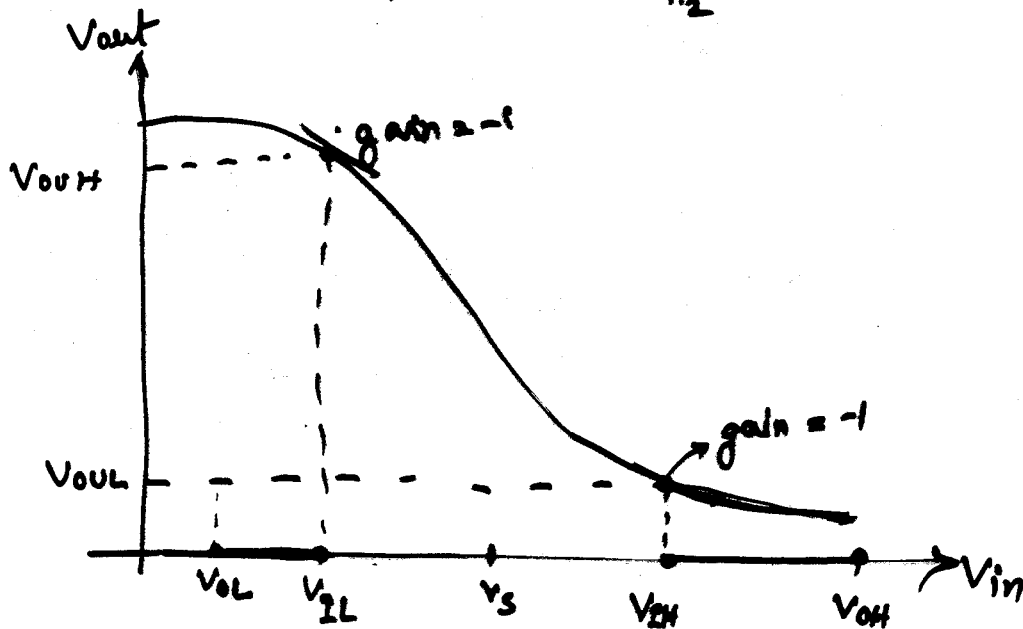
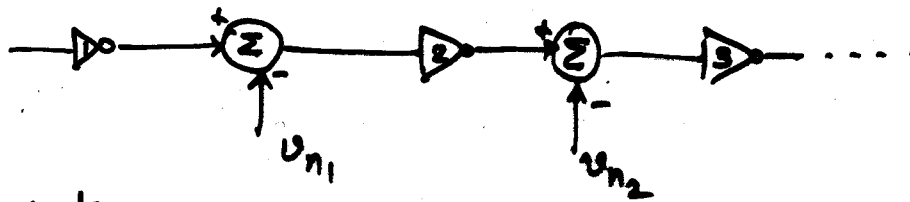
Single-source noise margin (SSNM)



$$SSNM_H = (V_{OH} - V_S)$$

$$SSNM_L = (V_S - V_{OL})$$

### Multiple - source NM



If the  $|gain| < 1$ , noise can't grow.

$$\left. \begin{aligned} NM_H &= V_{OH} - V_{IH} \\ NM_L &= V_{IL} - V_{OL} \end{aligned} \right\}$$