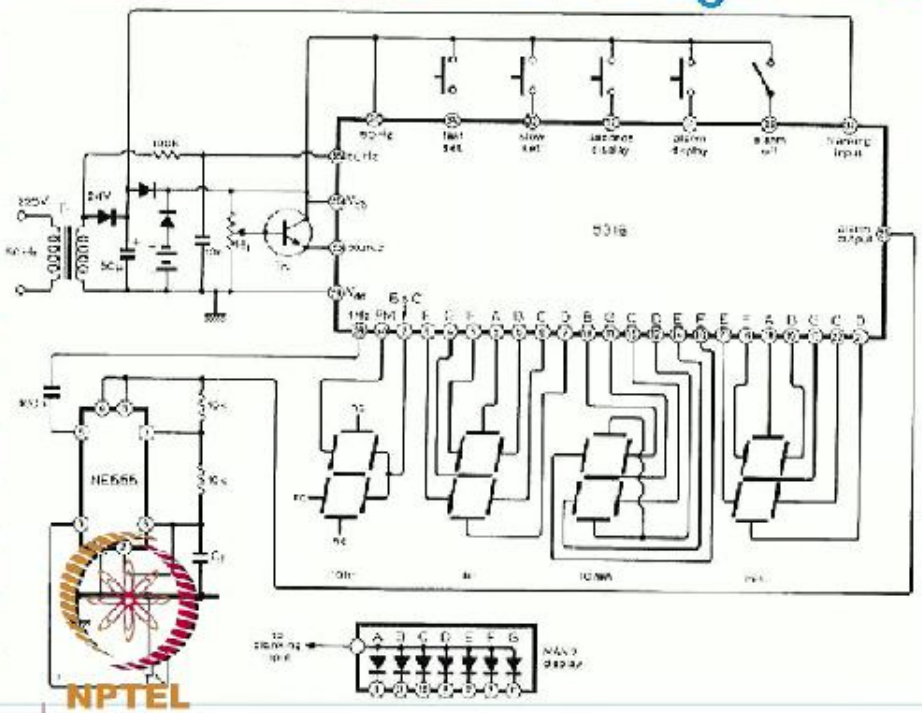
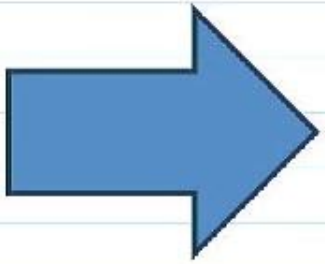
Electronic System Design :

A circuit can have multiple types of components :

1) R , L and C
2) Diodes , Transistors
3) Integrated Circuits
4) Displays , Buttons etc.

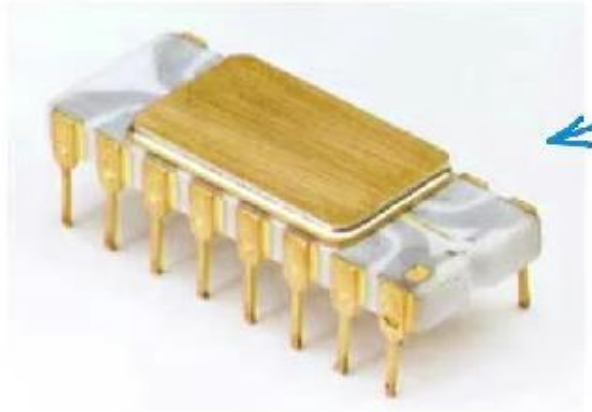
Electronic System Schematic



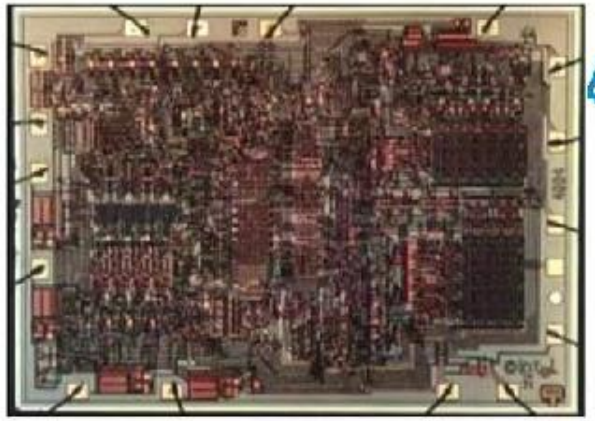


Intel's 4004 Microprocessor :

Many transistors connected together.



Packaged Microprocessor



4004 μprocessor

Die - photograph

NPTEL

MOSFET : Metal Oxide Semiconductor Field Effect Transistor

1) MOSFETs are most commonly used Field - Effect Transistor.

2) Mosfets are used in switching and amplifying signals.

3) Mosfets are voltage controlled devices.

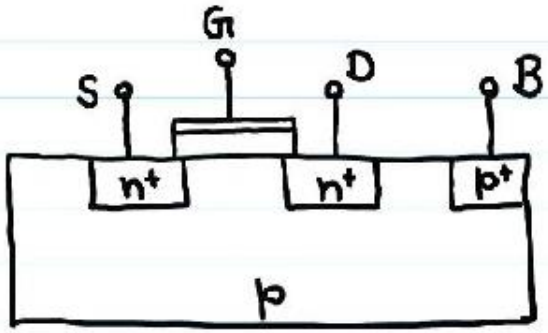
4) Mosfets are 4 - Terminal devices.

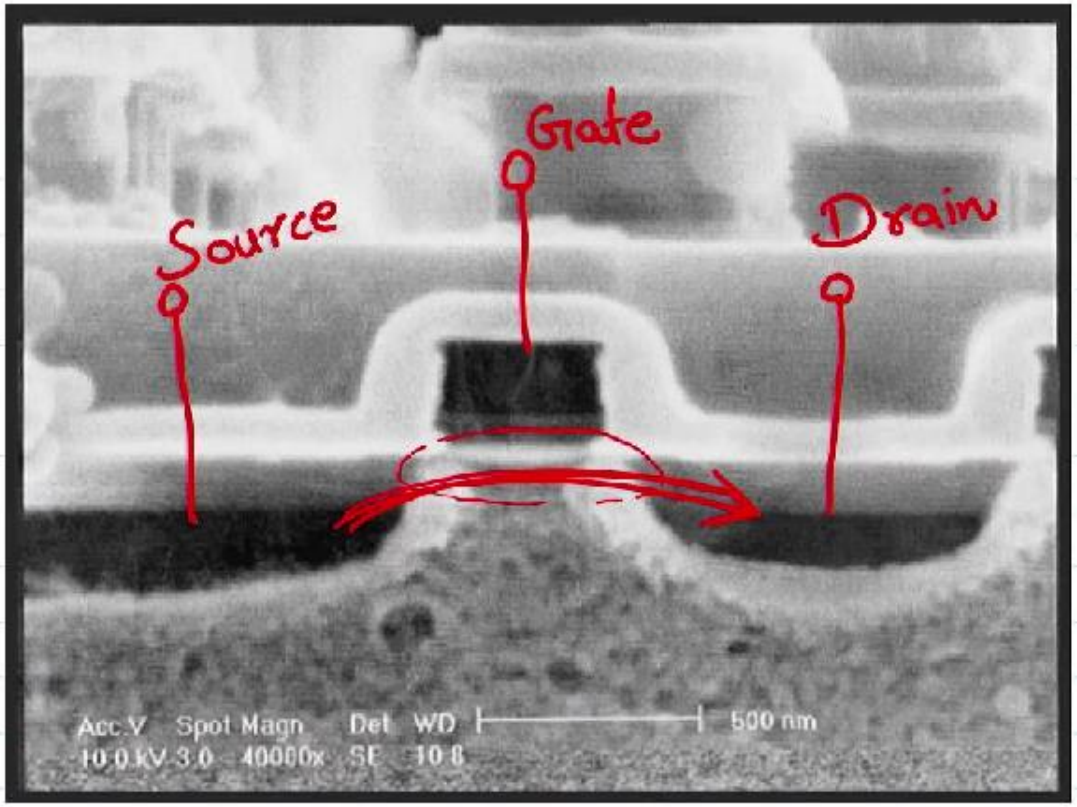
5) Mosfets have very high switching speed.

6) There are two classes of Mosfets
   a) Enhancement type.
   b) Depletion type.

7) There are two classes further
   a) N - channel
   b) P - channel.

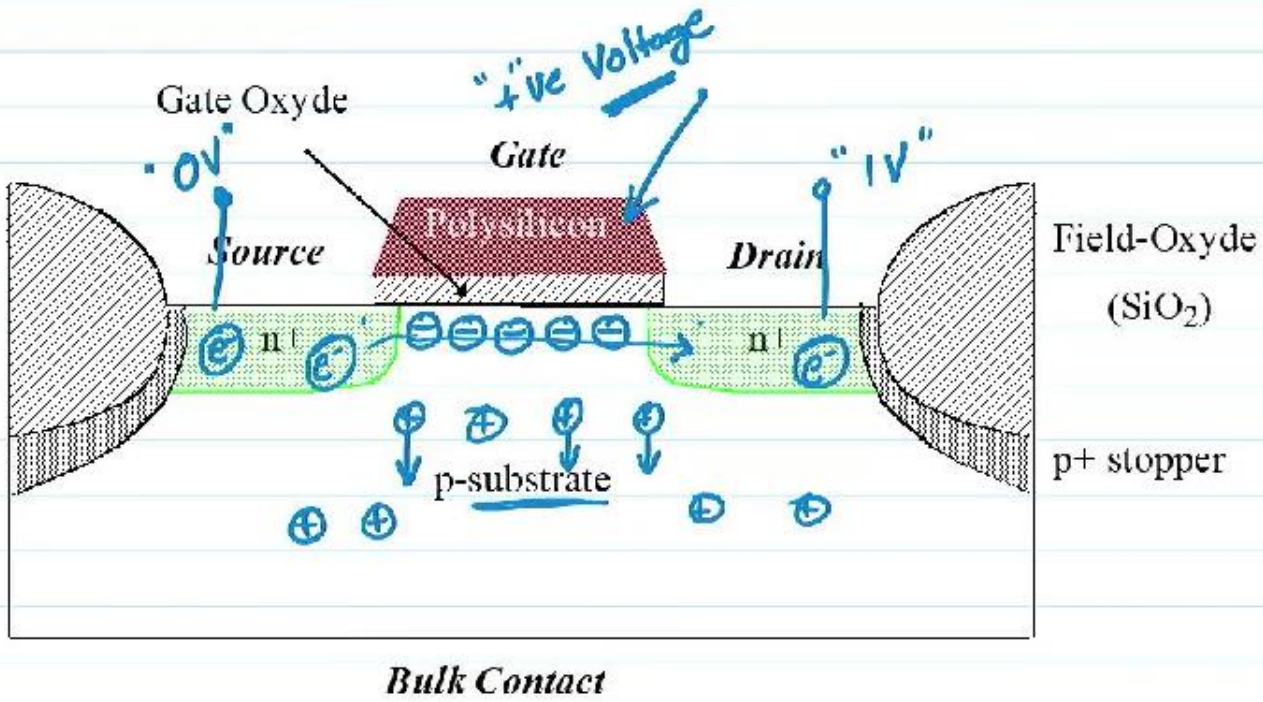
MOSFET Cross - Section :





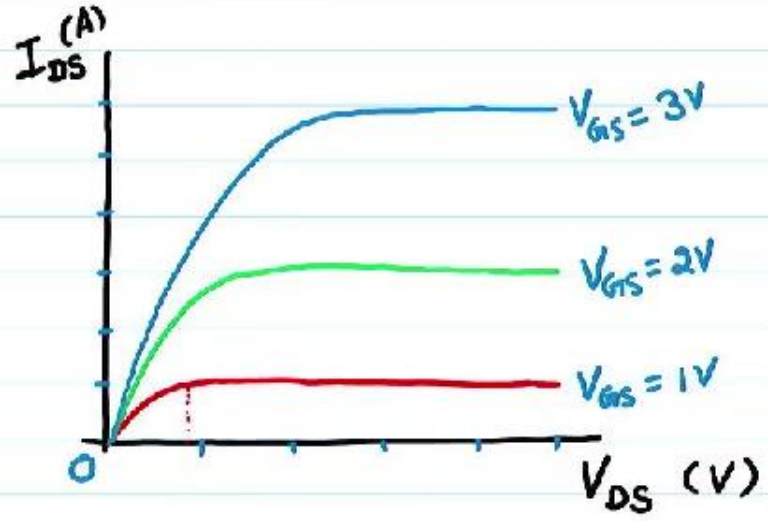
NPTEL

MOSFET Working :

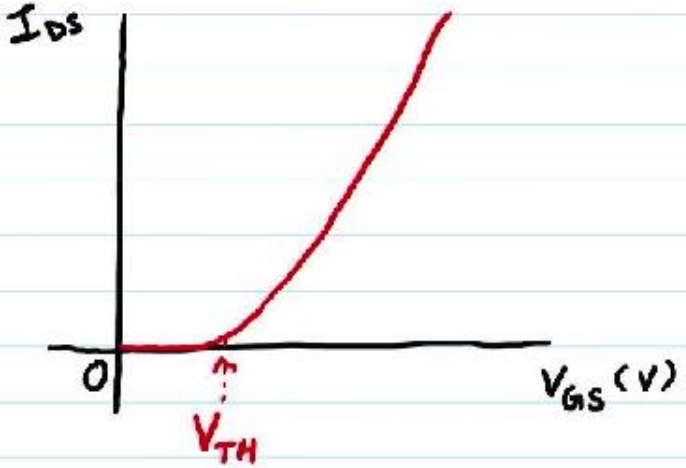


CROSS-SECTION of NMOS Transistor

at zero-bias → No current (I_{DS})



$I_D - V_{DS}$

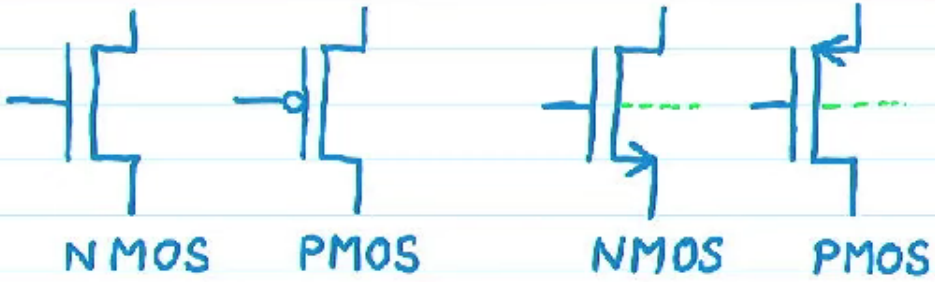


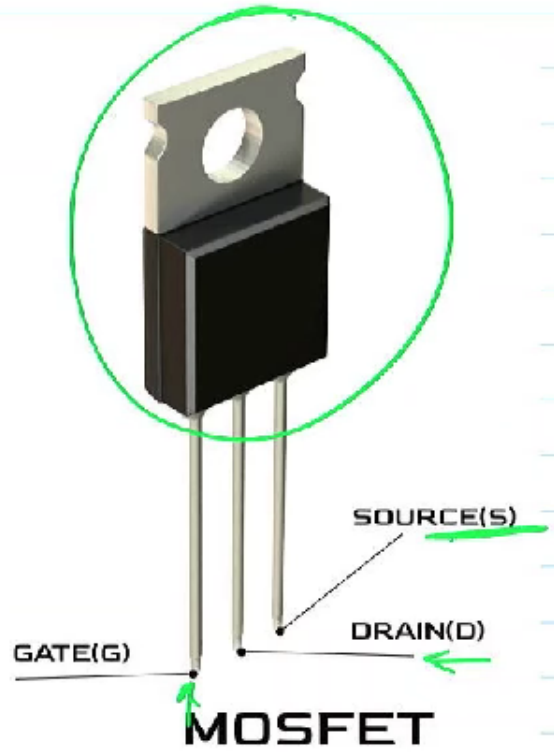
NPTEL

MOSFET Equations and Symbols :

$$I_D = \frac{1}{2}\mu_n C_{ox}\frac{W}{L}(V_{GS} - V_{TH})^2$$

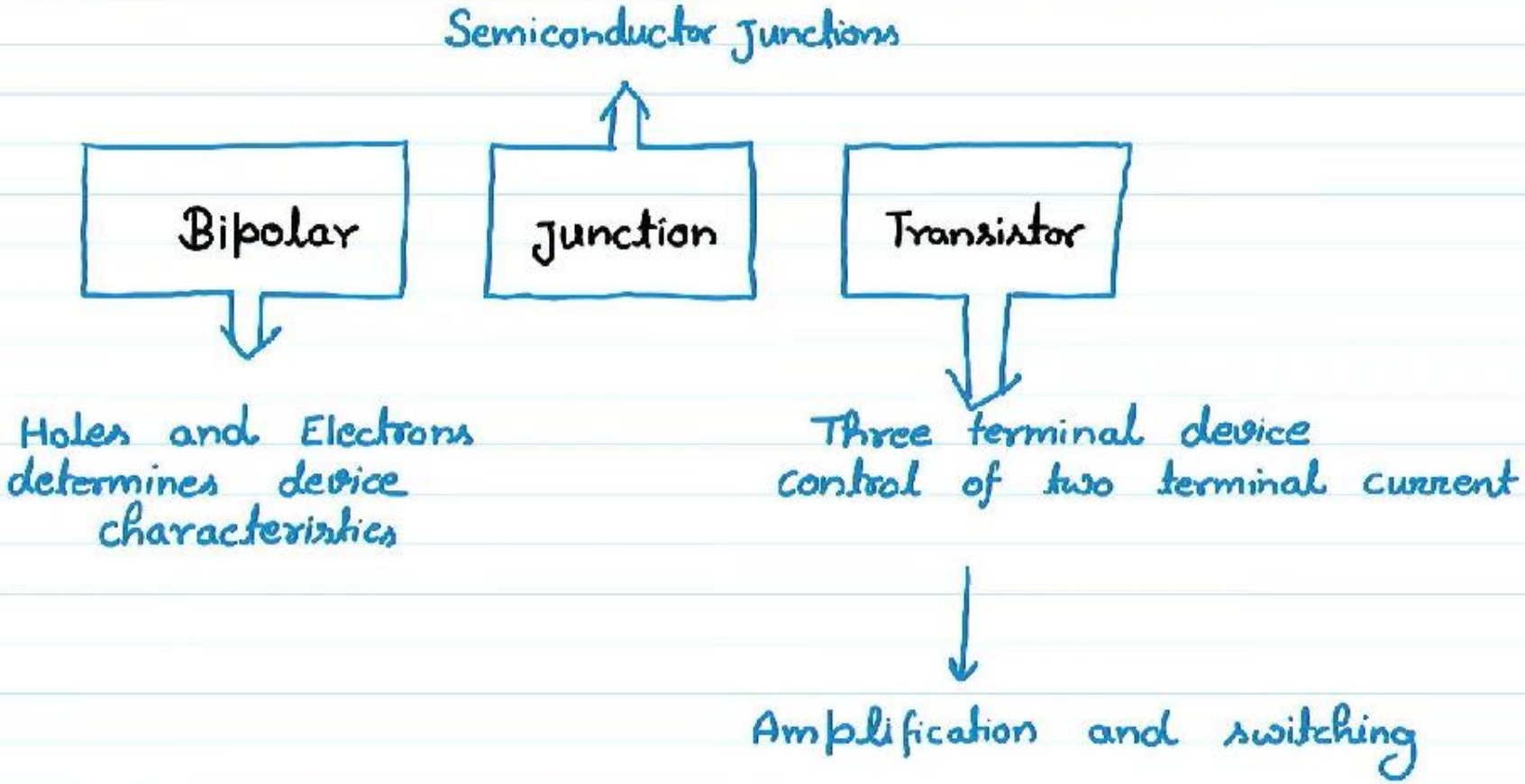
$$g_m = \frac{\partial I_D}{\partial V_{GS}} = \mu_n C_{ox}\frac{W}{L}(V_{GS} - V_T)$$





NPTEL

BJT :


Semiconductor Junctions
Bipolar
Junction
Transistor
Holes and Electrons determines device characteristics
Three terminal device control of two terminal current
Amplification and switching

NPTEL

Bipolar Junction Transistor :

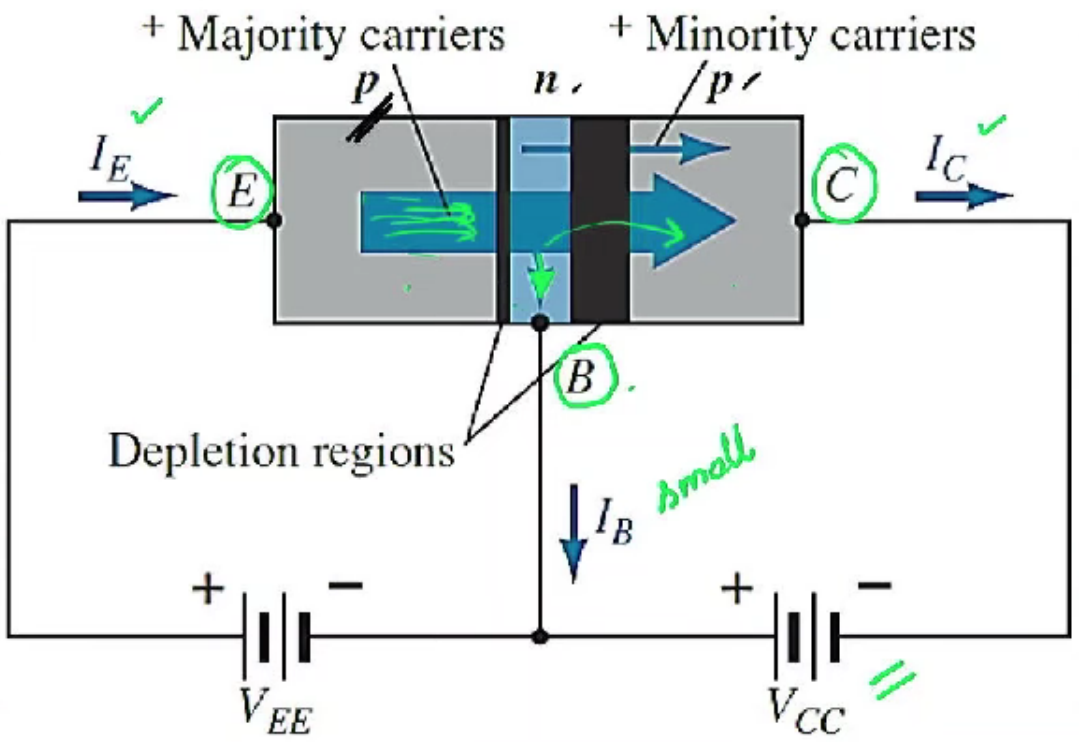
- A N-type silicon sandwiched between two p-type silicon.

  - Types of Transistor
    - npn
    - p-n-p

  - Three regions of transistor
    - Base
    - Emitter
    - Collector

  - Bipolar : Both e^- and h^+ contribute to current flow.

BJT Operation :



- E-B junction is forward biased
  C-B junction is reverse biased
- Base is very thin and lightly doped
- base current is very small.

$$I_E = I_C + I_B$$

BJT : Commercially available packages :