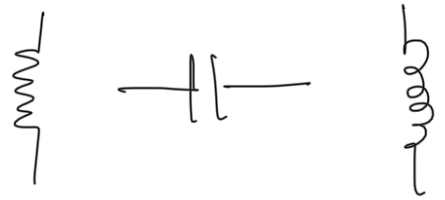
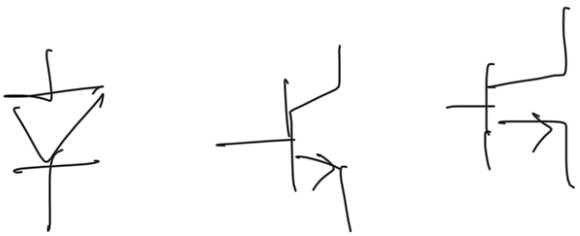
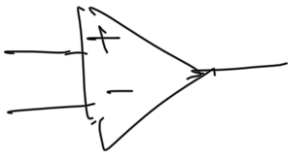
* Introduction

Basic Electric Components



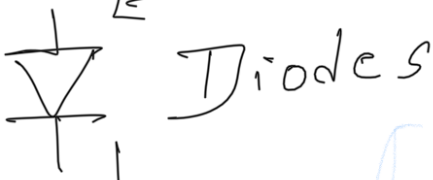
Electronics





* Outline

Semiconductor Physics



Diodes

Diode Circuits

Bipolor transistors

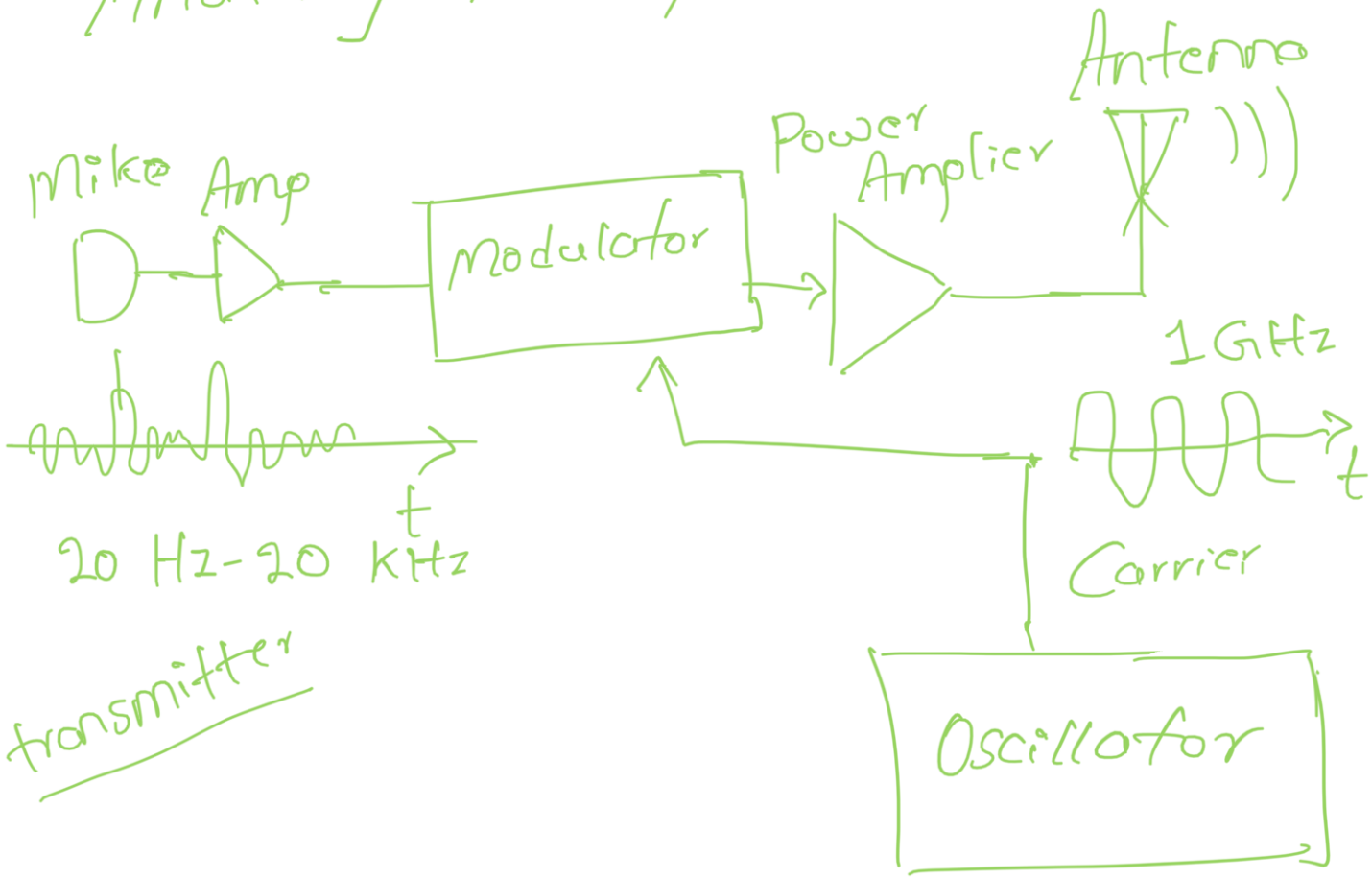
Bipolor Circuits

MOS transi-stors

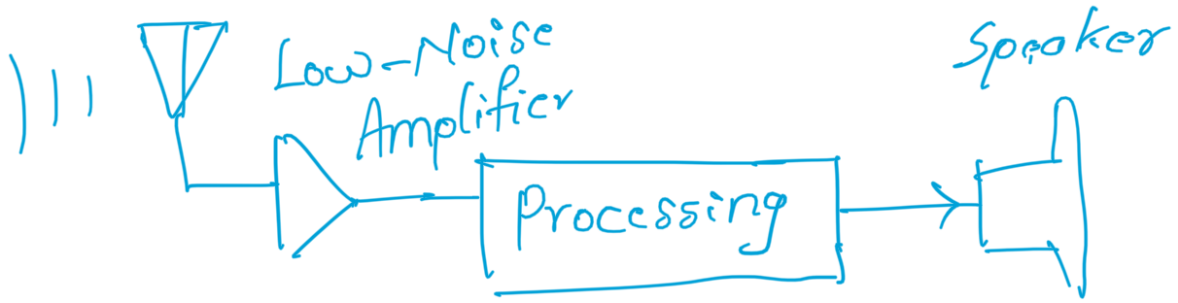
MOS Circuits

Op-Amp based circuits

Anatomy of Cellphone



transmitter



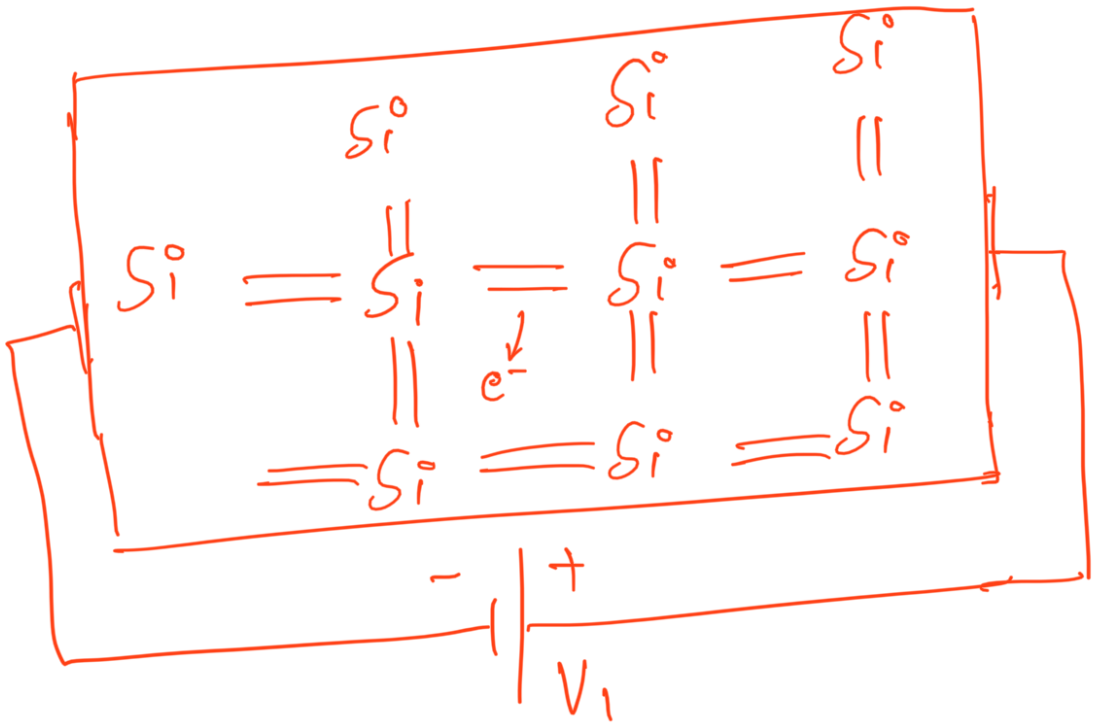
Receiver

* General Concepts

Sodium : 1 e^-

Neon : 8 e^-

Silicon : 4 e^-

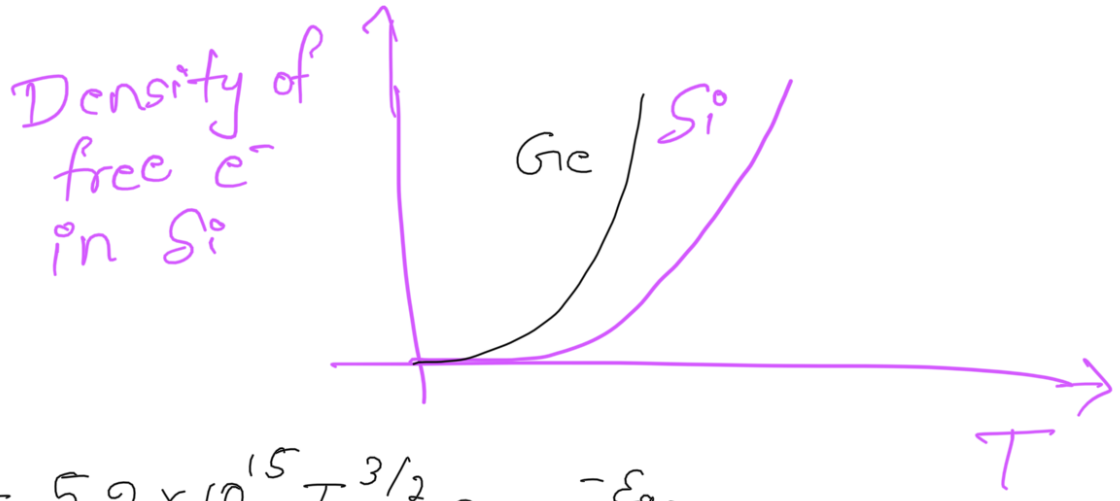


Questions:

1. Where do charge carriers come from?
2. What types of charge carriers do we have?
3. How can we modify density of charge carriers?

④ How do charge carriers move?

* Concept of bandgap energy:



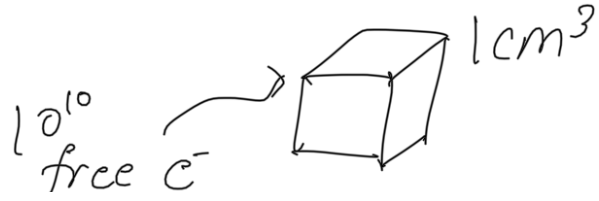
$$n_i = 5.2 \times 10^{15} T^{3/2} \exp \frac{-E_g}{2kT}$$

- n_i: Intrinsic Silicon
- E_g: Bandgap energy
- k: Boltzmann's Const. 1.38×10^{-23} J/K

E_g: 1.12 eV → Si
0.67 eV → Ge
2.5 eV → Diamond

Example: For Si, at $T = 300K$,

$n_i \cong 10^{10}$ electrons/cm³



5×10^{22} Si atoms/cm³ in which only 10^{10} free e^- because of thermal energy. (poor conductor) [pure Silicon aka intrinsic Si]

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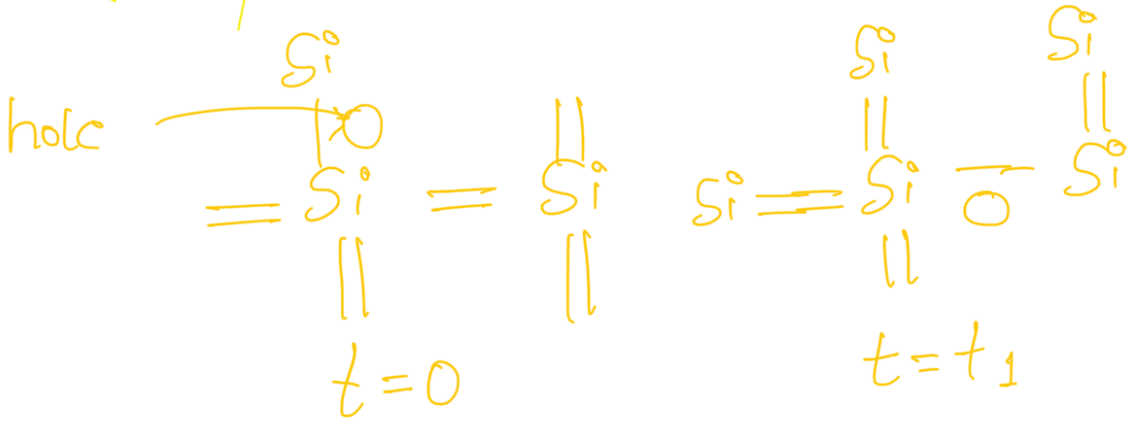
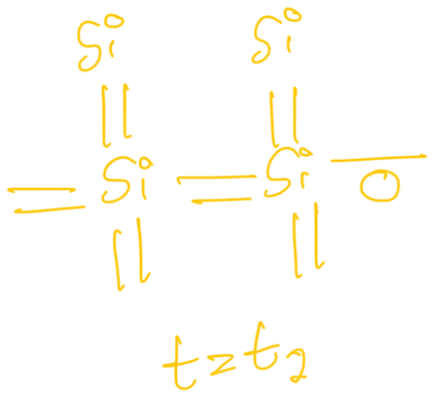
* Concept of holes:





+ve charge travelled from left to right here

Question: Why are holes slower than electrons?
Movement of holes is based on release and trap mechanisms.

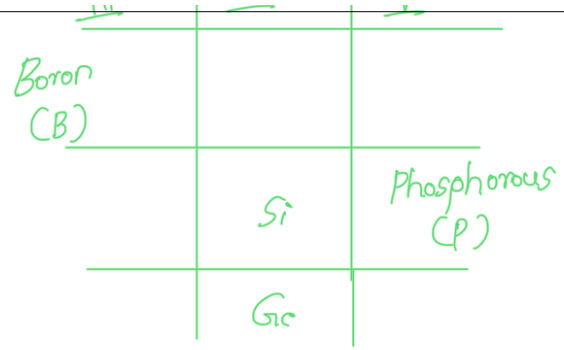
Density of holes = Density of Electrons = n_i (for pure Si)

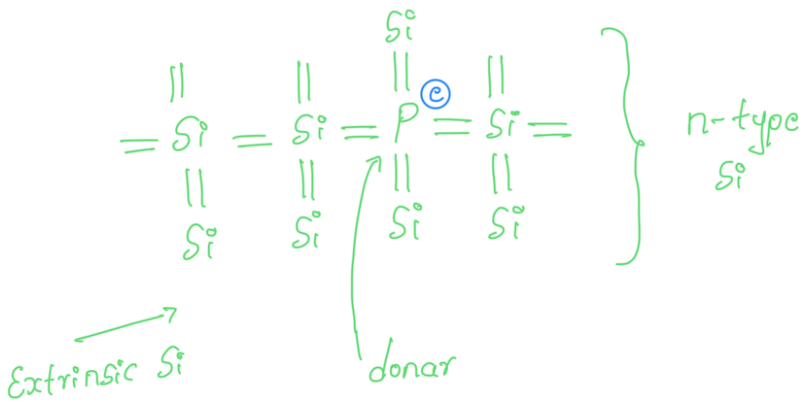
$p = n = n_i$

$pn = n_i^2$

Doping

III | IV | V





N_d = Density of P atoms $\approx 10^{15}$-10^{17} /cm³

$n \approx$ Density of P atoms $\approx N_d$

$np = n_i^2$ ($\because$ p goes down)