1) LTspice

2) Optoelectronics : Chapter 3

→ PN-junction : if light strikes it with sufficient energy → e^-'s will jump the semiconductor bandgap and create an e^-/hole pair

Light ⇒ photons : $E_p \equiv$ energy in the photon

For e^- bandgap jump : $E_p \geq E_G$ {bandgap energy}

$$E_p = h\nu = \frac{hc}{\lambda}$$

h = Planck's constant = 6.626×10^{-34} J·s

ν = light frequency

c = speed of light = 3×10^8 m/s

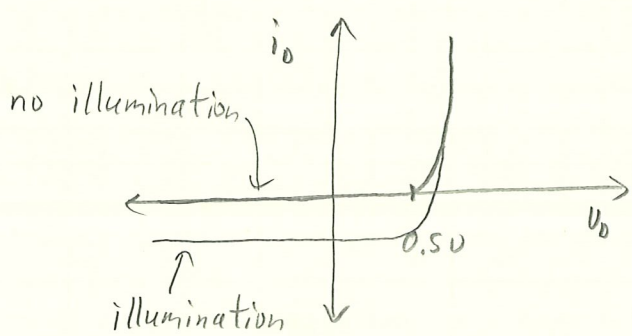
λ = light wavelength

Wavelength → show plot

Frequency ↑ : Wavelength ↓

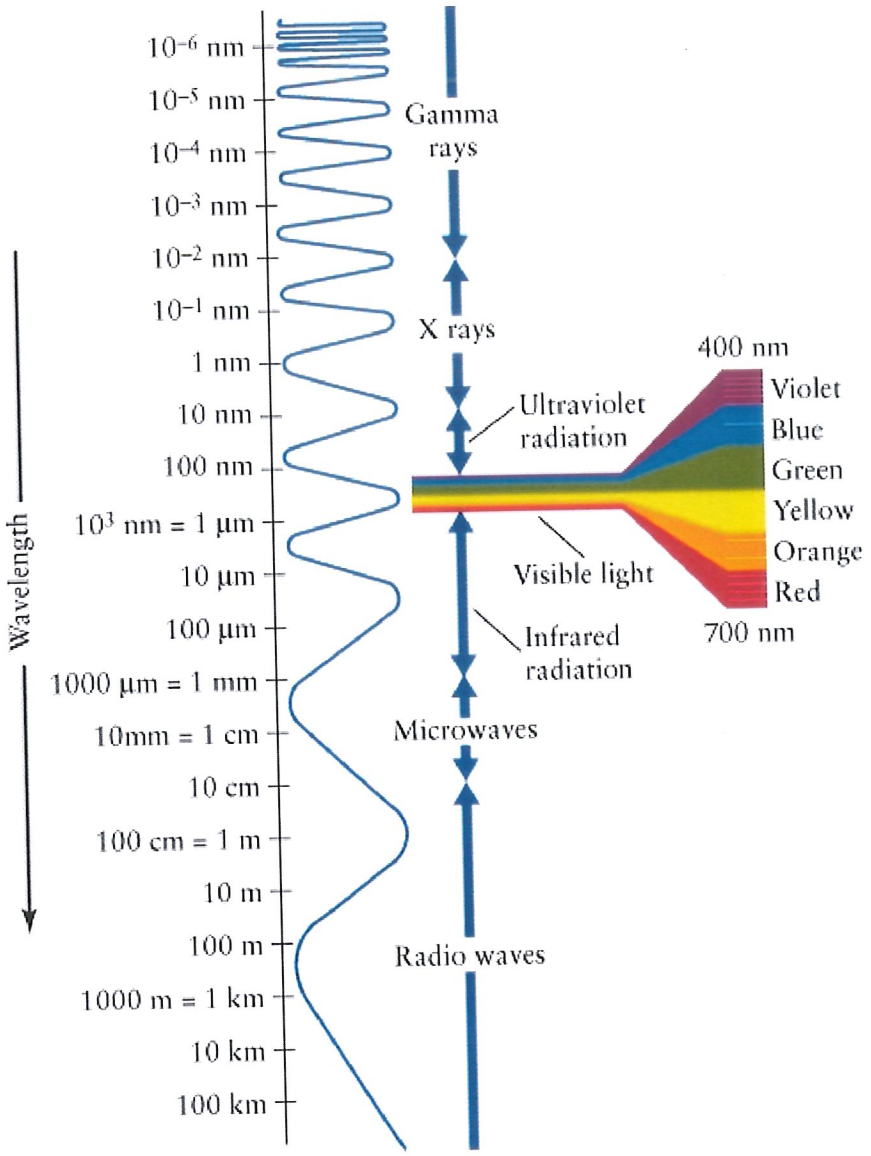
Frequency ↑ : E_p ↑

a. Effect of light on a pn-junction diode



Illumination increases the reverse bias current → called $i_{PH} \equiv$ photon-generated current

Wavelength of Electromagnetic Radiation:

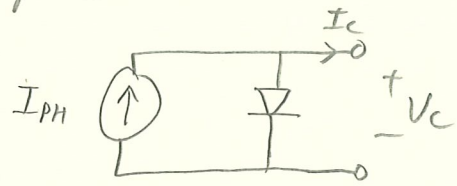


From: http://eosweb.larc.nasa.gov/EDDOCS/Wavelengths_for_Colors.html

a pn junction diode used for this purpose → called a "photo diode"

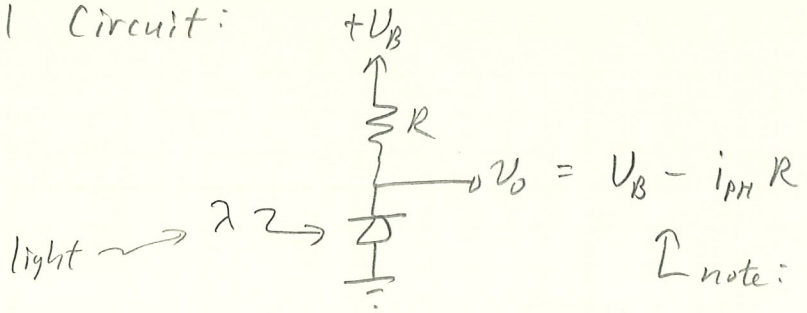
Semiconductor devices used for this purpose (including photo diodes) are called photodetectors

Model for a photodiode:



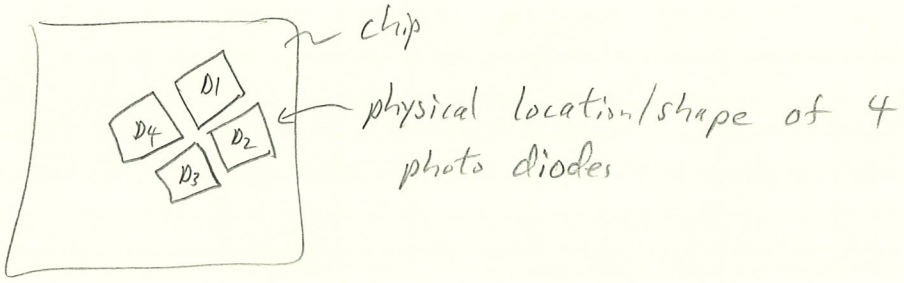
Uses: fiber optic communications, optical detectors/sensors

Typical Circuit:



note: book has this wrong

4-Photodiode Quad Detector



→ light ideally shines in the center of Quad Cell → all 4 photo diodes have same current output

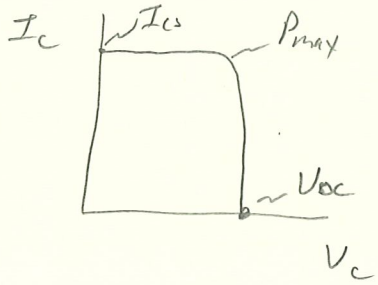
→ if light is not centered → output currents not equal → Comparing the 4 output currents yields the light beam

location → Centroiding

→ Similar sensor used in CD + DVD players to keep the laser beam on track

b. Solar or Photovoltaic Cells

pn junction optimized for power production



I_{cs} → short circuit current : $I_{c_{max}}$ → but $V_c = 0$

V_{oc} → open circuit voltage : $V_{c_{max}}$ → but $I_c = 0$

P_{max} → I_c and V_c for maximum output power

c. Light-Emitting Diodes → LED

→ pn junction → e^- + hole recombine and release energy

Si → this energy is not optimized for visible light

other semiconductors (GaAs, etc) → visible light LED's

↓

red, orange, green, blue

↓

white

↓

blue w/ white phosphorous coating

→ also have IR, UV + laser diodes

→ also have LCD (liquid crystal display)

Optoelectonics is a <u>BIG</u> area