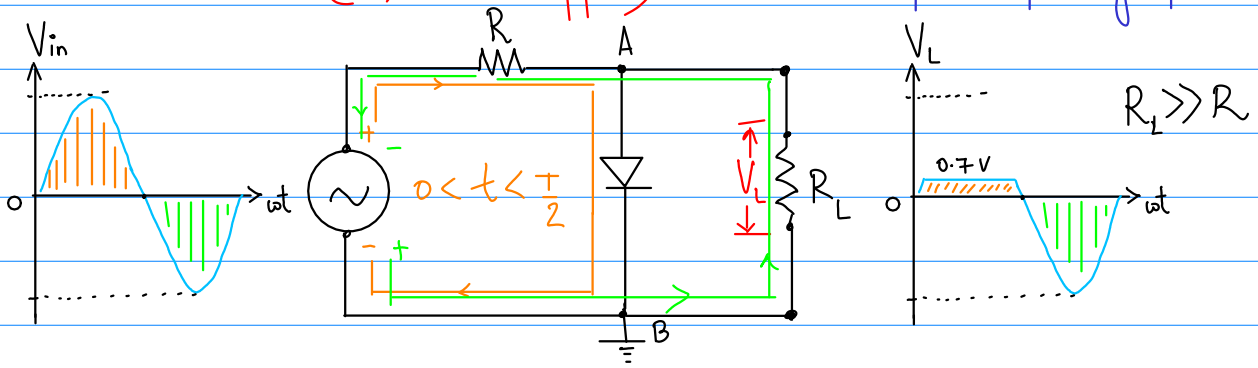
17.10.2023

Application of p-n diodes: Limiters (Clippers) & Clampers

(1) Voltage Limiters (Clippers):

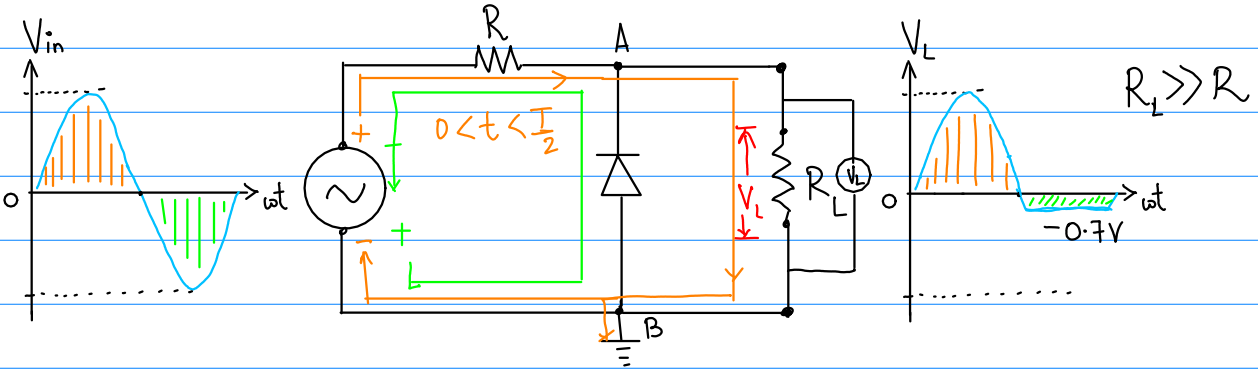
(a) Positive Limiter (or, +ve clipper): Limit/Clip +ve part of input voltage.



$$V_L = \frac{R_L}{R_L + R} V_{in} \quad ;$$

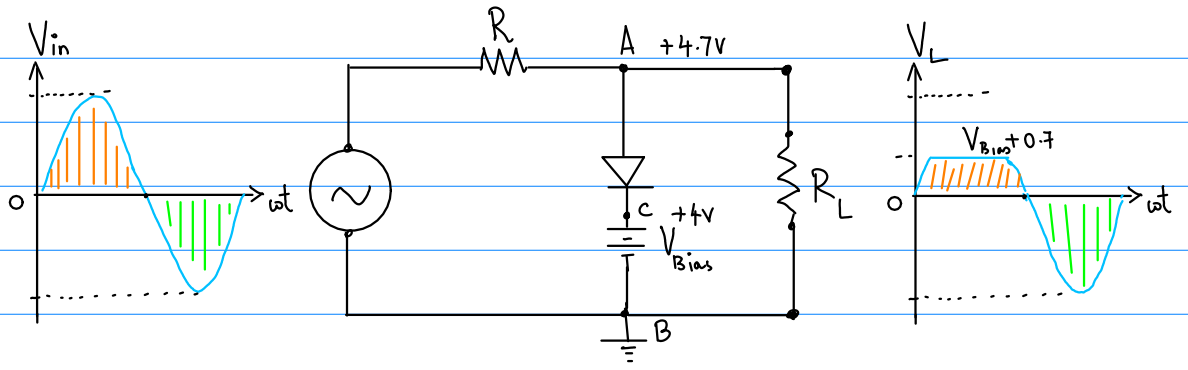
if $R_L \gg R$, then $V_L \approx V_{in}$

(b) Negative Limiter (or, −ve clipper): Limit/Clip −ve part of input voltage.

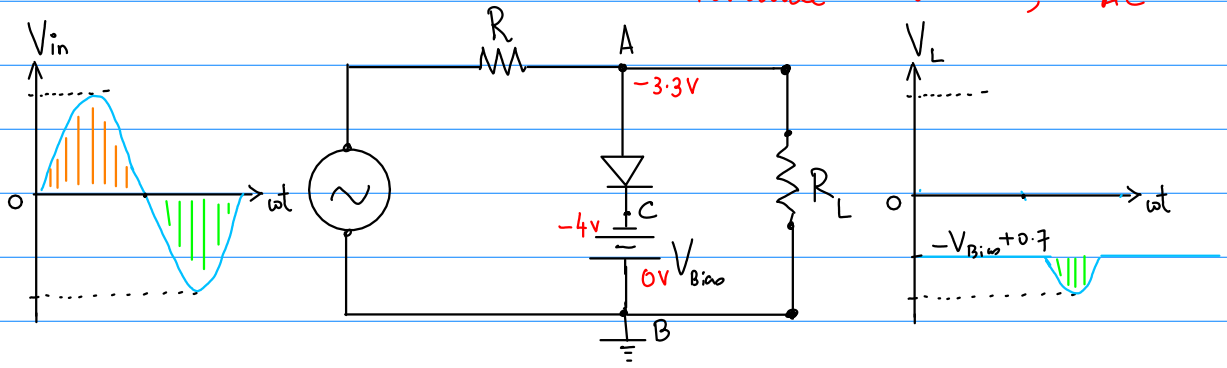


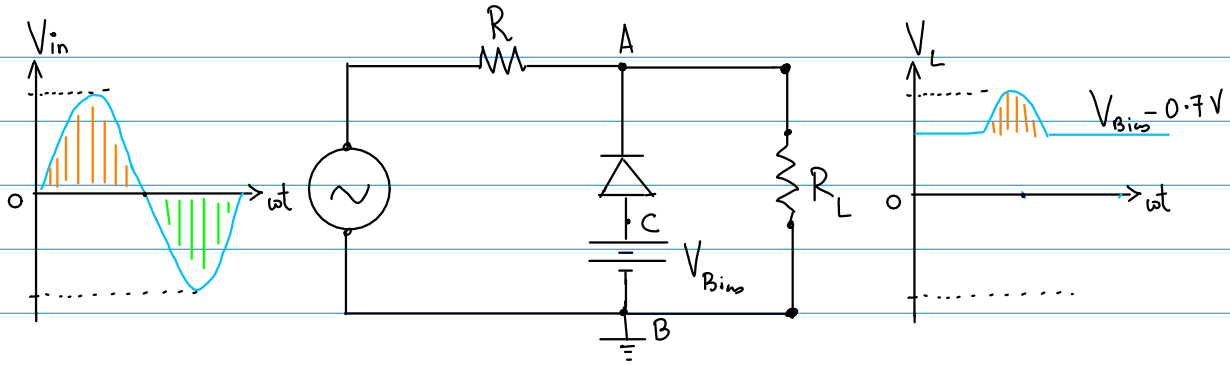
Bias Limiters (Clippers):

Remember: For a diode to turn-ON; $V_{AC} \geq 0.7V$

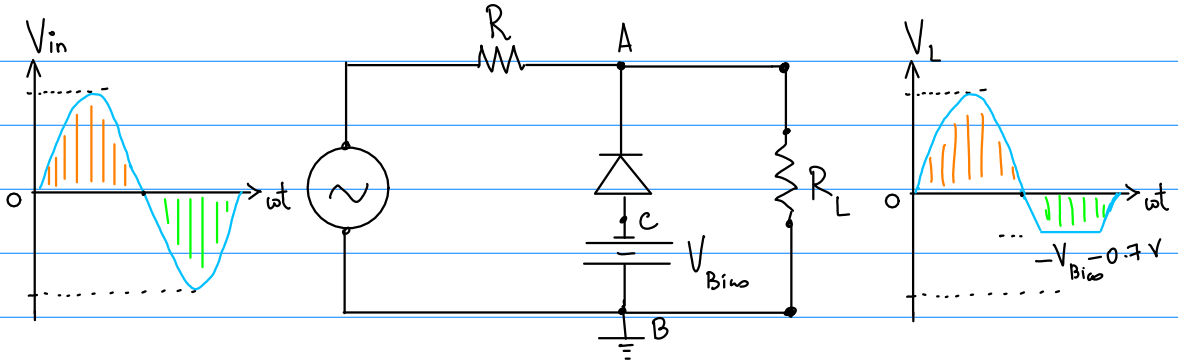


For diode to turn-ON; $V_{AC} \geq 0.7V$

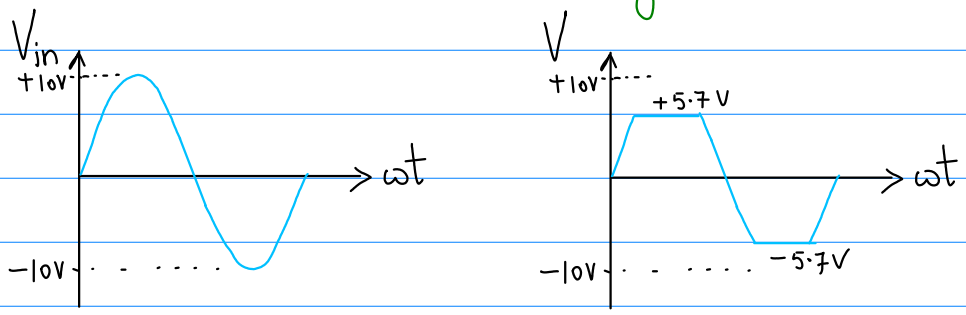




For diode to turn-ON; $V_{CA} \geq 0.7V$



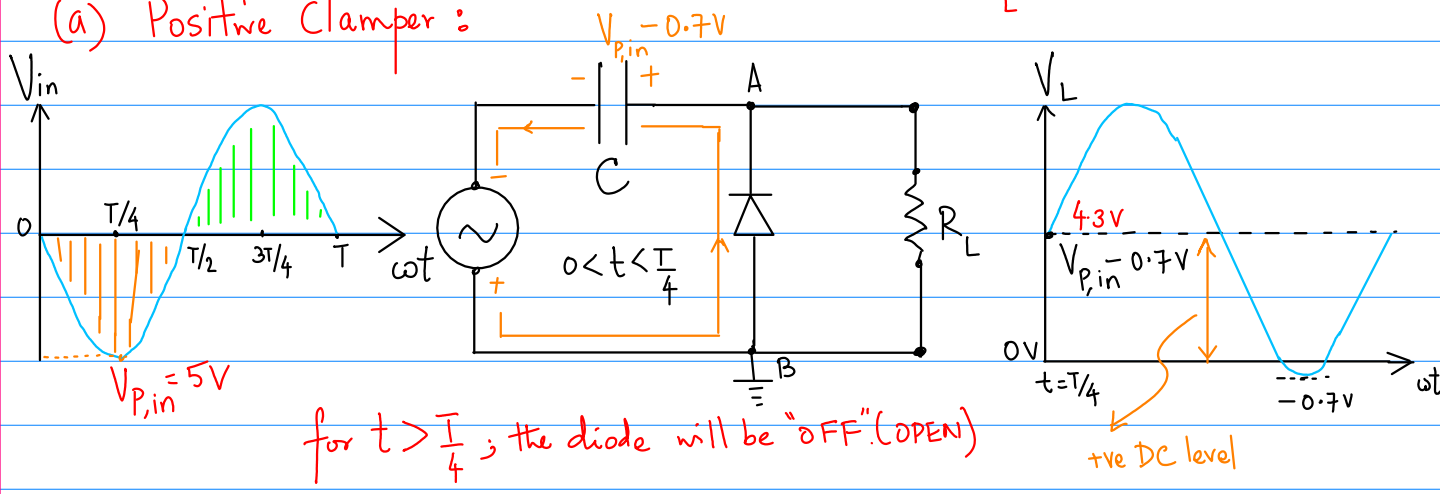
Assignment: Design a circuit using diodes, resistors & DC Bias to get the following output for an input sinusoidal signal.



(2.) Clampers: A clamper adds a dc level to an ac voltage.

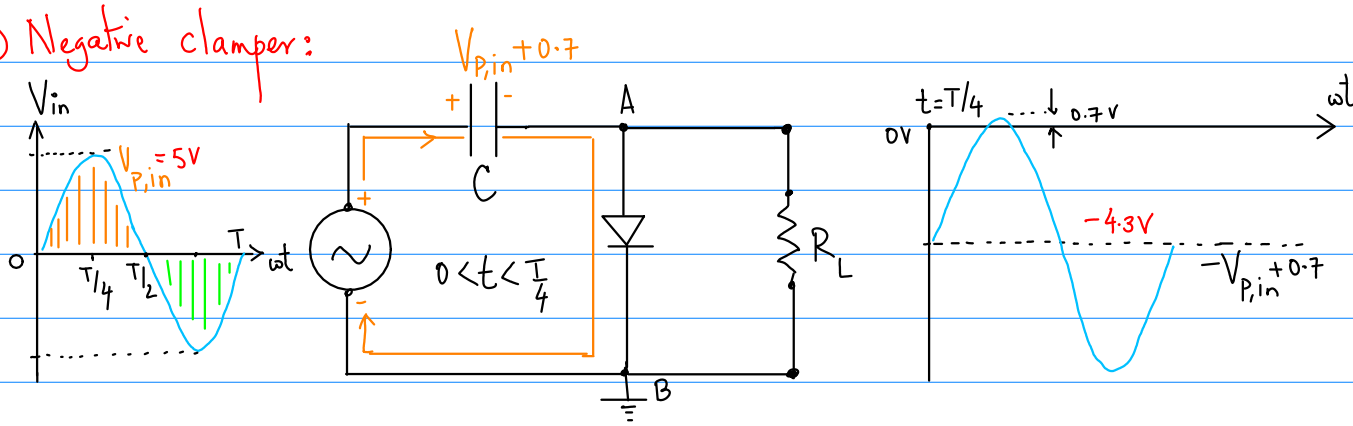
$\tau = R_L C \gg T$

(a) Positive Clamper:



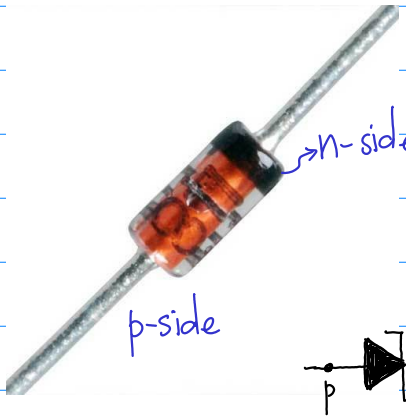
for $t > \frac{T}{4}$; the diode will be "OFF" (OPEN)

(b) Negative clamper:

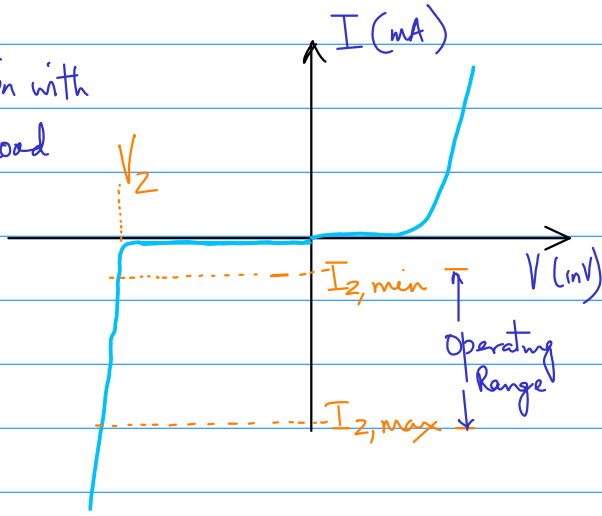


Special Purpose Diodes

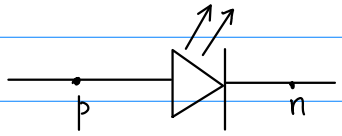
1. Zener Diode – Voltage Regulation



Regulation with
- Changes in load resistance
- Changes in the input voltage.

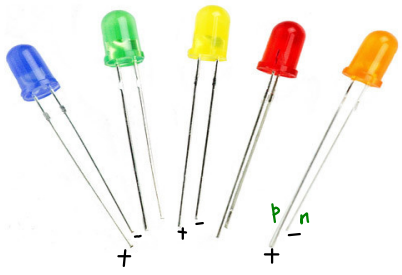


2. Light-emitting Diodes (LEDs):

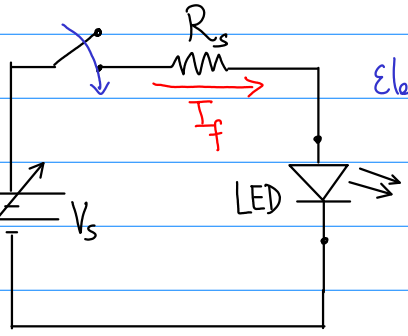


– Convert electrical energy in light energy

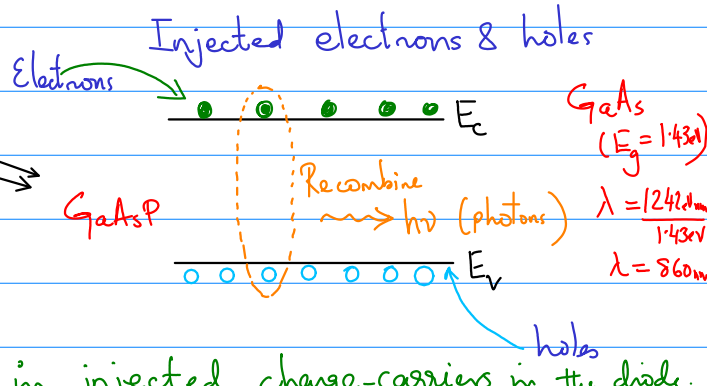
– Process is termed as "Electroluminescence". (Mechanism)



$$I_f \uparrow = \frac{V_S \uparrow - V_D}{R_s}$$

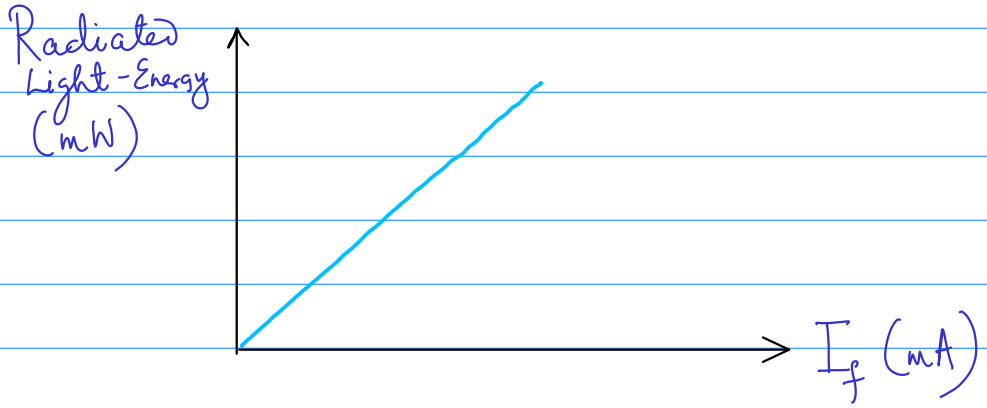


Band-gap Engineering



Increase in I_f ⇒ Increase in injected charge-carriers in the diode.

$\Rightarrow$ More probability of recombination $\Rightarrow$ more light photons

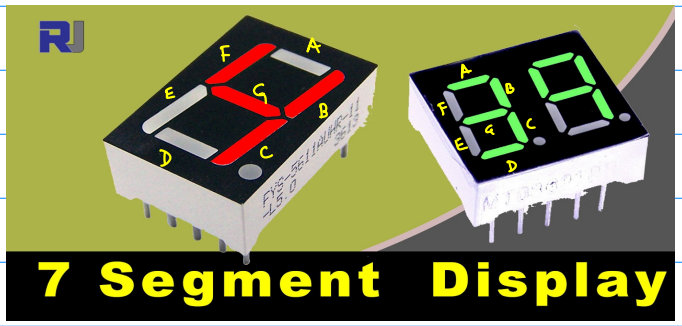


Application of LEDs :

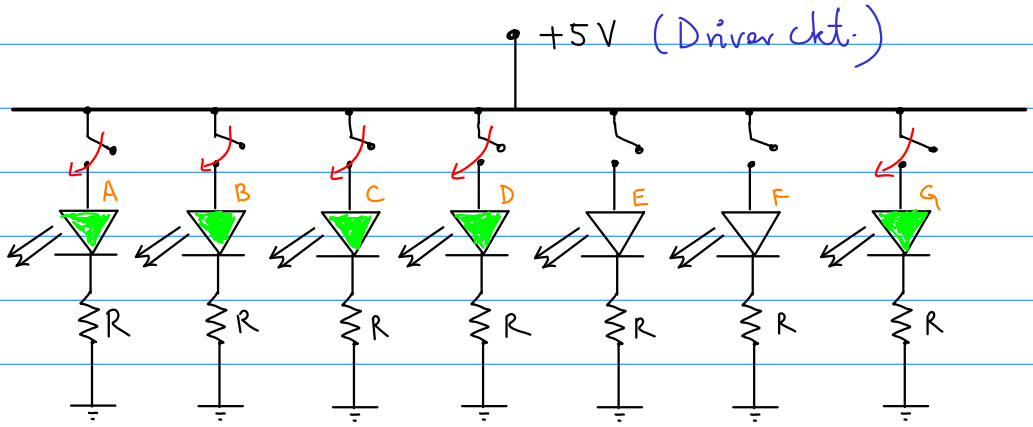
(i) As a power indicator.

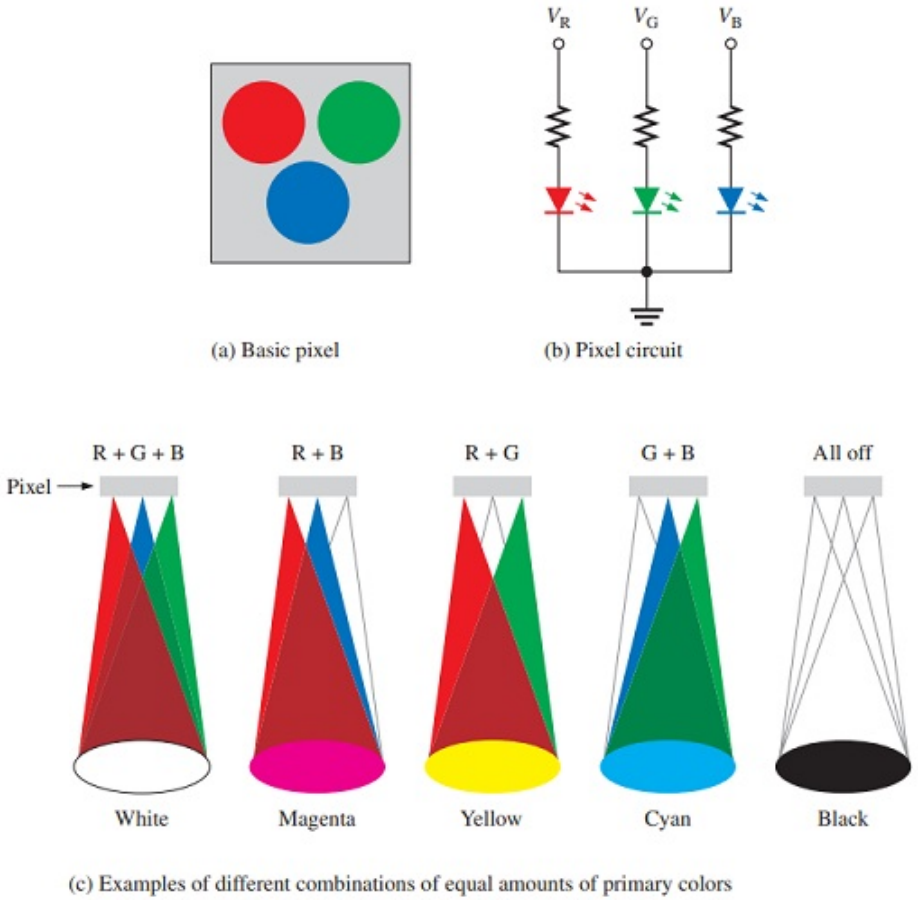
(ii) Lighting.

(iii) Displays :



7 LEDs

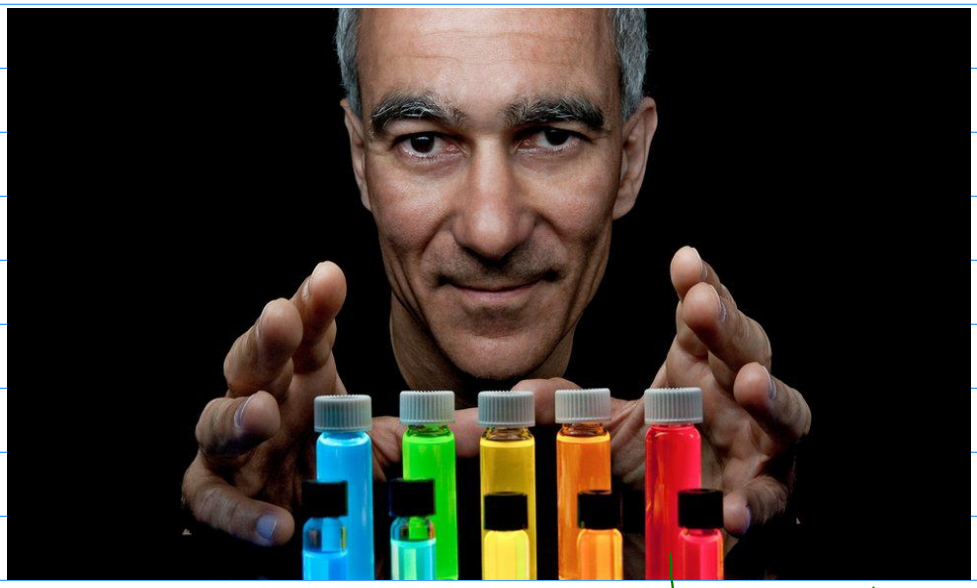




▲ FIGURE 3–41

The concept of an RGB pixel used in LED display screens.

Prof. M. Bawendi, MIT.

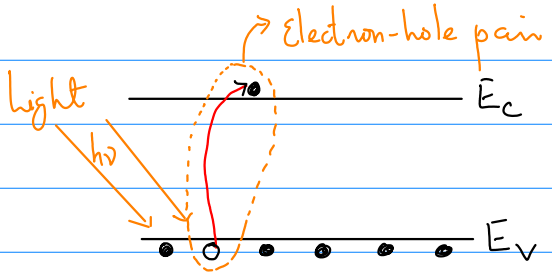


CdSe QDs

Tune the Band-gap just by changing the size of the QDs

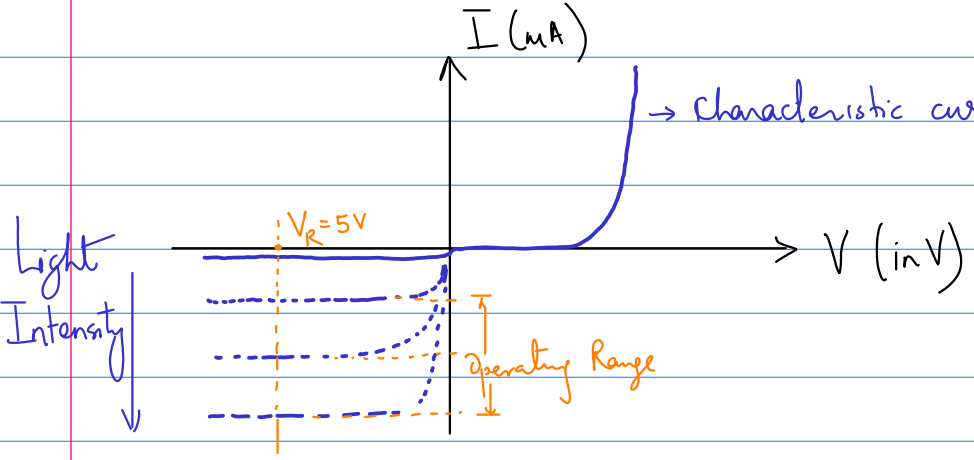
↳ Quantum Dots. (Artificial Atoms)

③ Photo-diode :

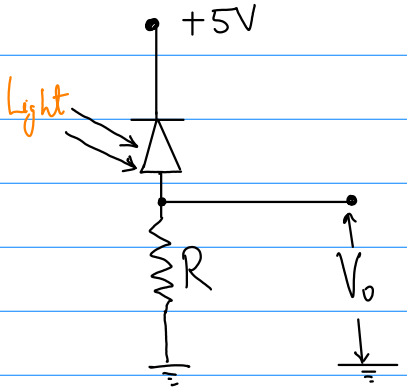


Light absorbing material : Generating electron-hole pairs

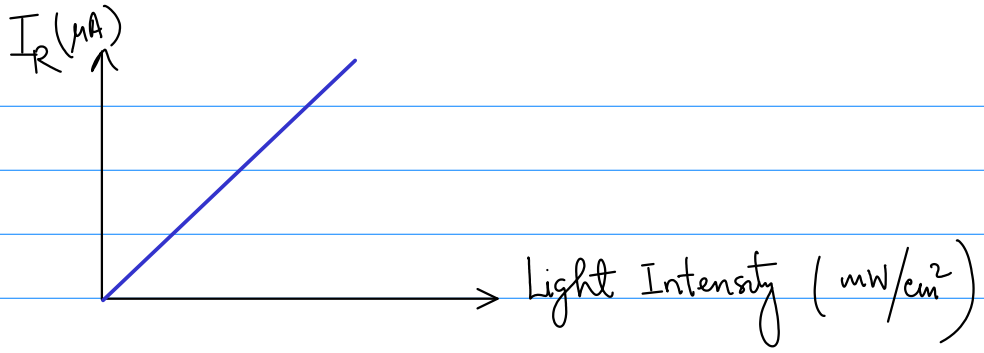
if the generated electron-hole pairs are dissociated, then "free" charge-carriers are released.
These charges constitute electric-current in external ckt.



Ckt. application :

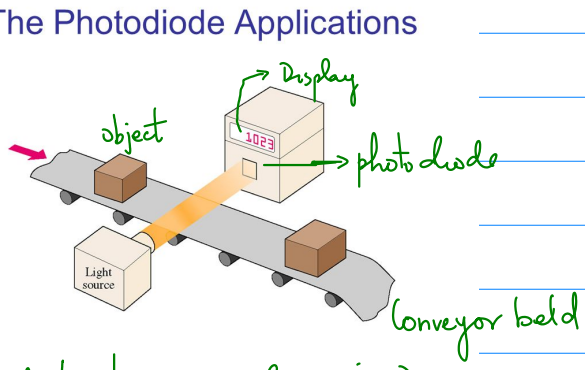


V_o is directly proportional to the light intensity



Application of photo-diodes:

(i) Electronic Counter:



(ii) LiDAR (Light detection and Ranging): Remote Sensing