# Unit-3

# Lecture -1

Optical Sources, Requirements, N& P type material, Structures, Considerations

# Considerations with Optical Sources

- Physical dimensions to suit the fiber
- Narrow radiation pattern (beam width)
- Linearity (output light power proportional to driving current)

# Considerations with Optical Sources

- Ability to be directly modulated by varying driving current
- Fast response time (wide band)
- Adequate output power into the fiber

# Considerations…

- Narrow spectral width (or line width)
- Stability and efficiency
- Driving circuit issues
- Reliability and cost

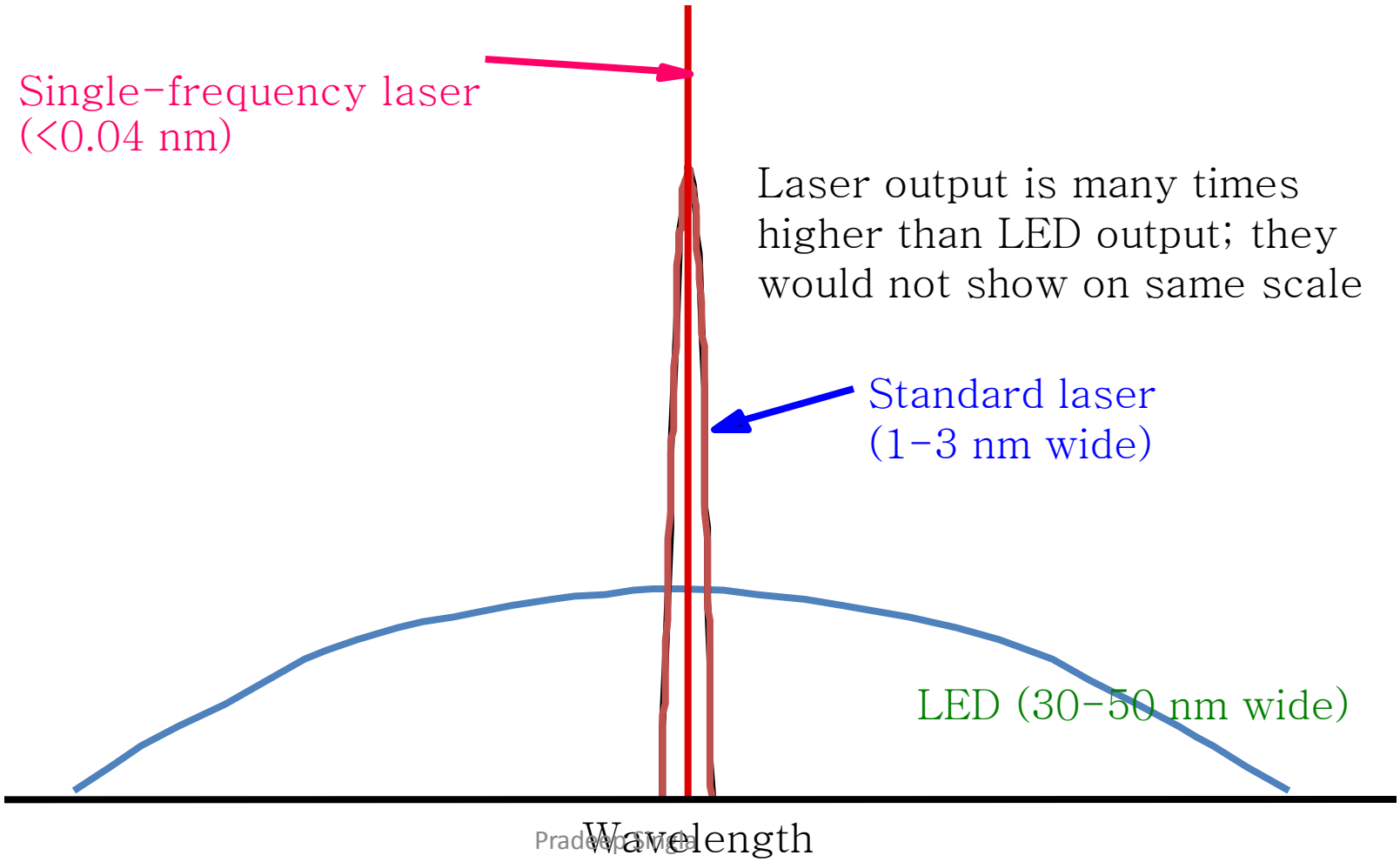
# Semiconductor Light Sources

- A PN junction (that consists of direct band gap semiconductor materials) acts as the *active* or *recombination* region.

- When the PN junction is forward biased, electrons and holes recombine either *radiatively* (emitting photons) or *non-radiatively* (emitting heat). This is simple LED operation.

- In a LASER, the photon is further processed in a resonance cavity to achieve a *coherent, highly directional* optical beam with *narrow linewidth.*

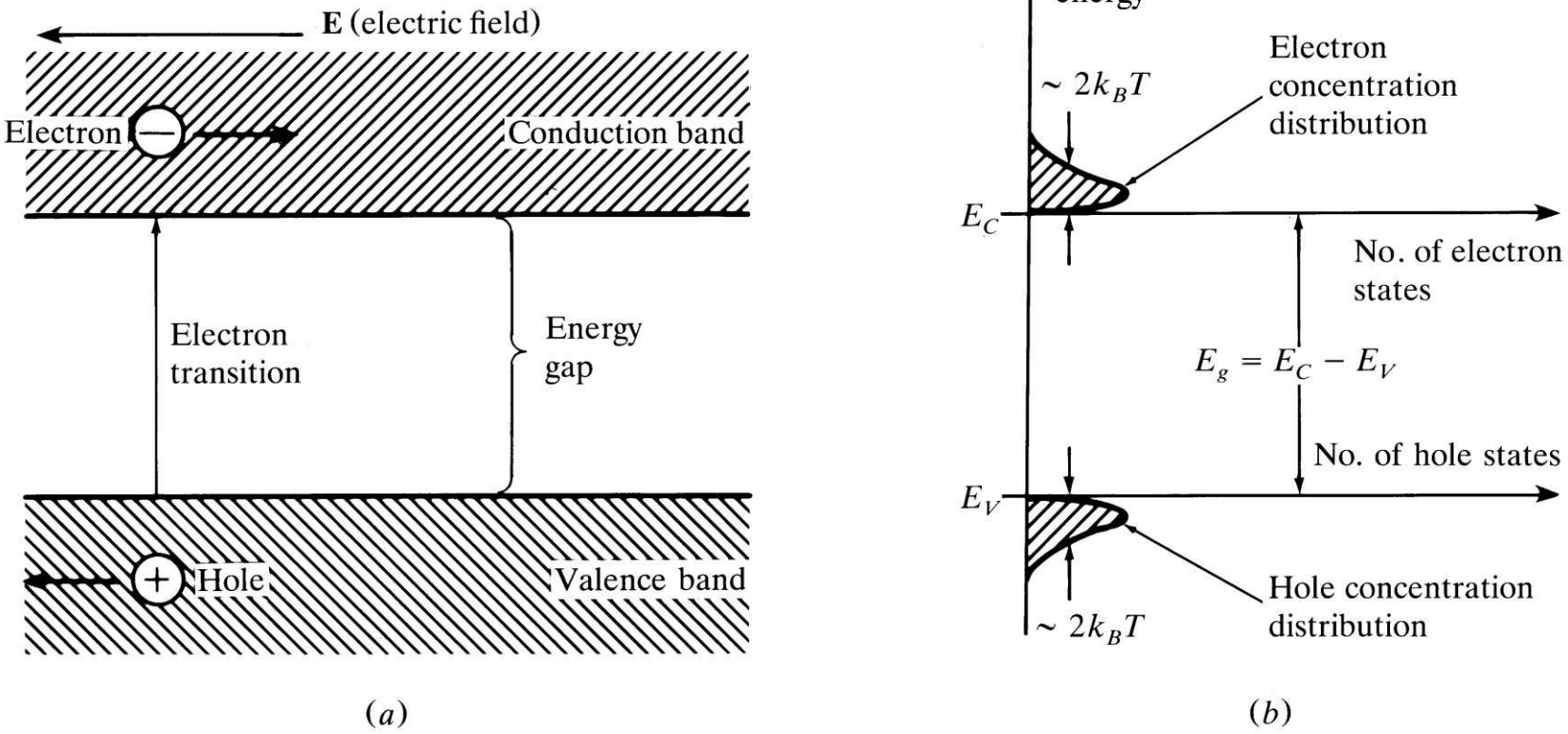
# LED vs. laser spectral width



# Light Emission

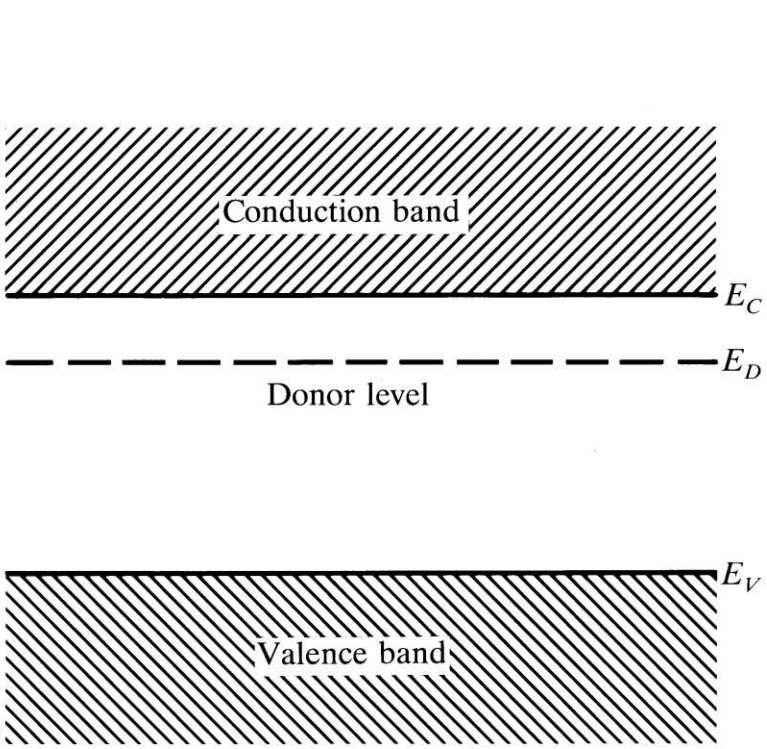
- Basic LED operation: When an electron jumps from a higher energy state ($E_c$) to a lower energy state ($E_v$) the difference in energy $E_c$- $E_v$ is released either
  - as a photon of energy $E = h\nu$ (radiative recombination)
  - as heat (non-radiative recombination)

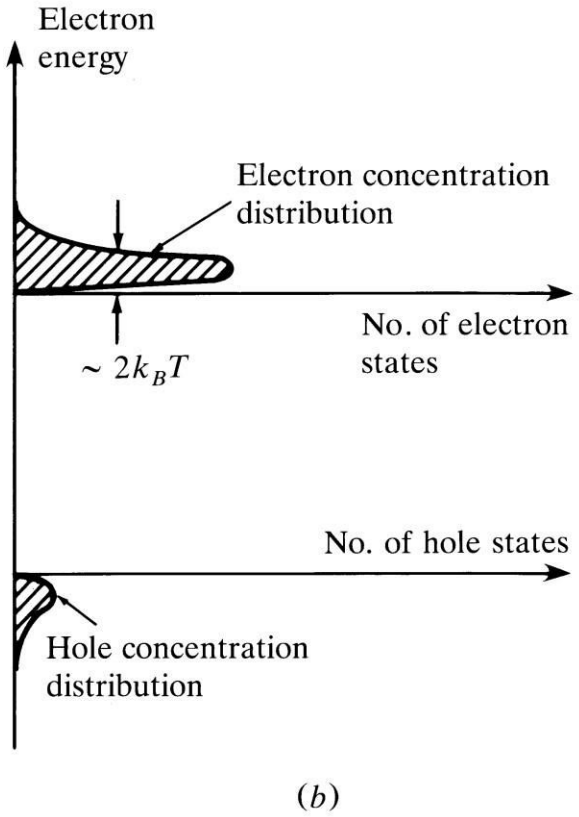
# Energy-Bands




In a pure Gp. IV material, equal number of holes and electrons exist at different energy levels.

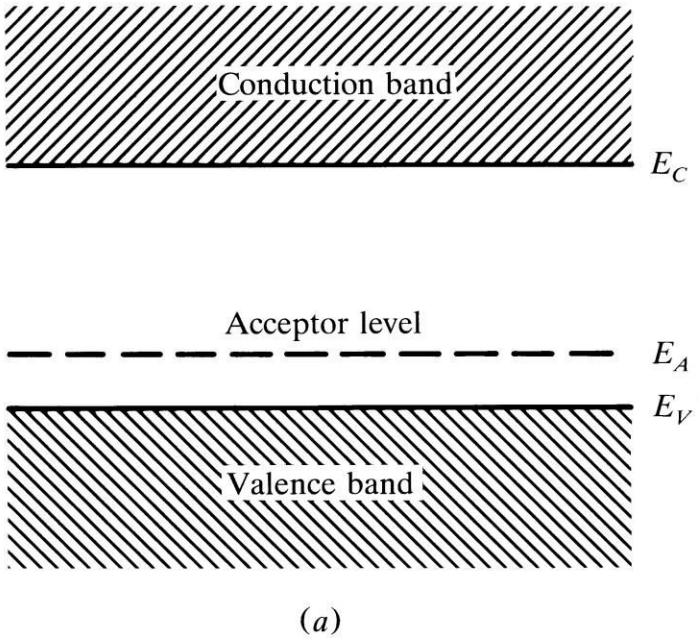
# n-type material

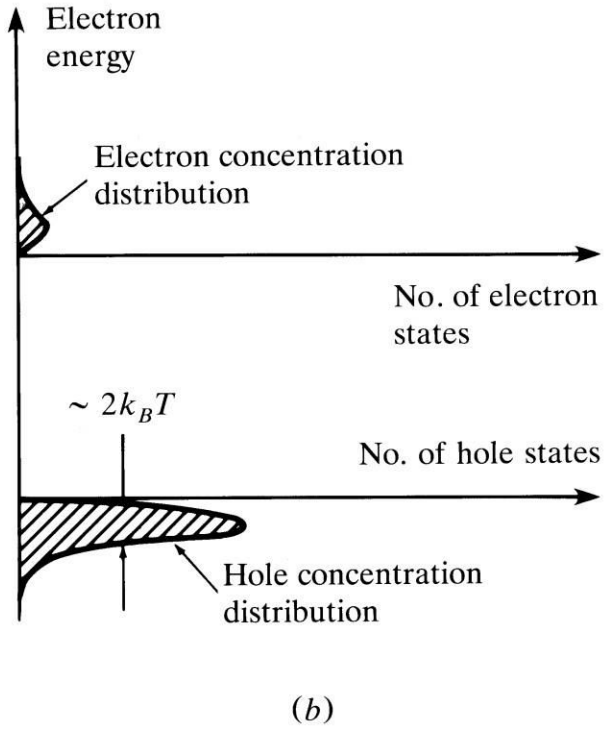



Adding group V impurity will create an n- type material

# p-type material




Adding group III impurity will create a p-type material