



SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)



COIMBATORE-35

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DEPARTMENT OF BIOMEDICAL ENGINEERING

COURSE NAME: 19EIB201/ ELECTRONIC DEVICES

II YEAR / III SEMESTER

Unit 1 – PN Junction Devices

Topic 2: Photo Diode

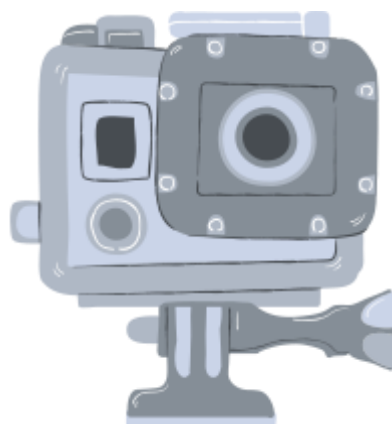
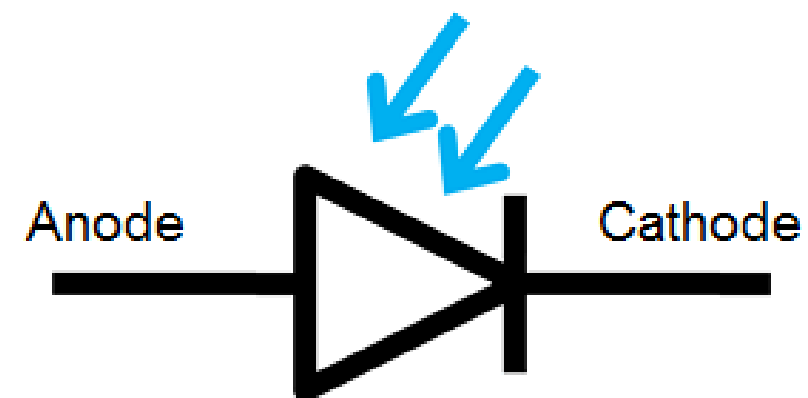




Photo Diode

- A photodiode is a p-n junction or pin semiconductor device that consumes light energy to generate electric current. It is also sometimes referred as photo-detector, photo-sensor, or light detector.
- Photodiodes are specially designed to operate in reverse bias condition.
- PIN (p-type, intrinsic and n-type) structure is mostly used for constructing the photodiode instead of p-n (p-type and n-type) junction structure because PIN structure provide fast response time.



Photodiode symbol



Photo Diode Working

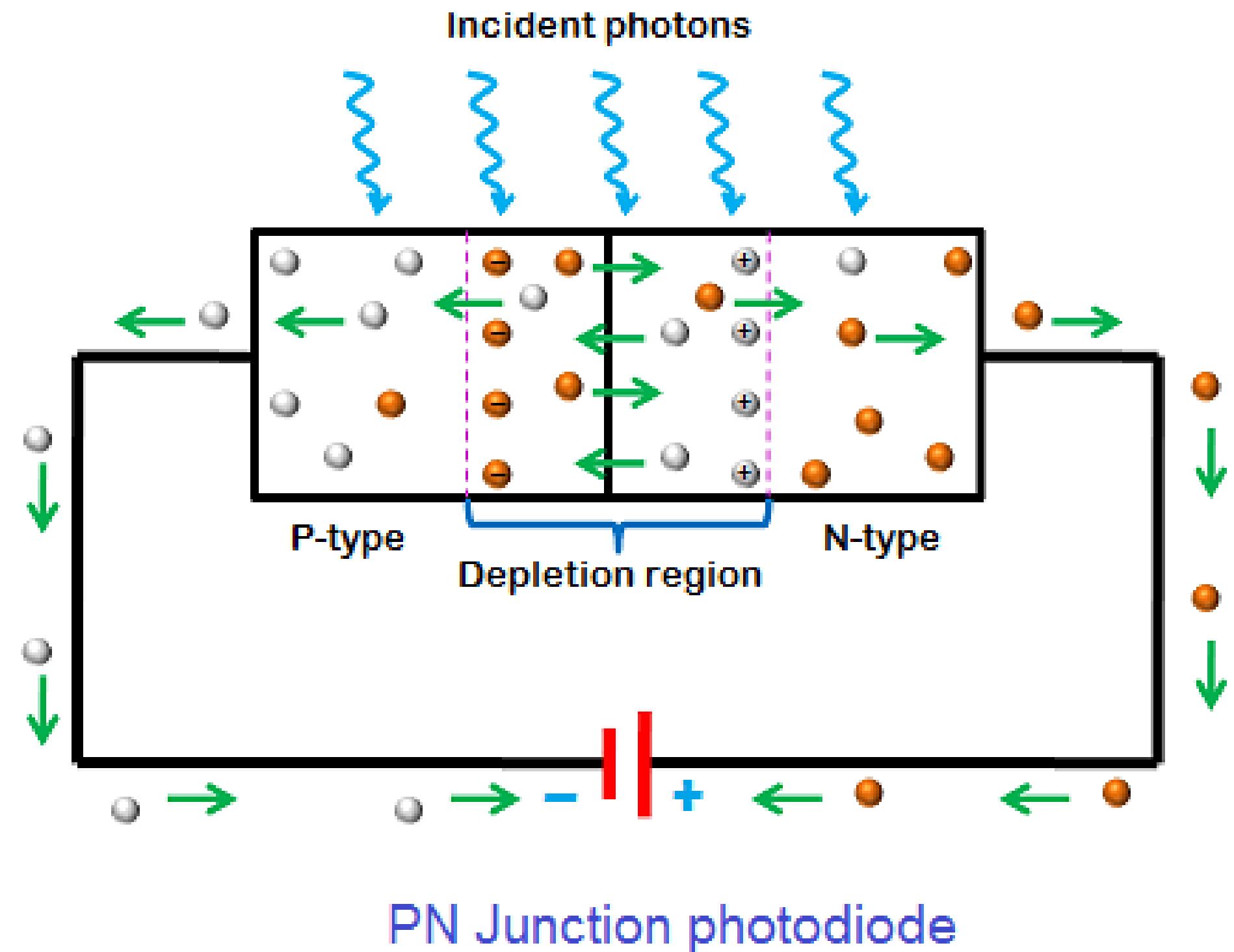


- A normal p-n junction diode allows a small amount of electric current under reverse bias condition.
- To increase the electric current under reverse bias condition, we need to generate more minority carriers.
- A special type of diode called photodiode is designed to generate more number of charge carriers in depletion region.
- The different types of photodiodes are
 - ✓ PN junction photodiode
 - ✓ PIN photodiode
 - ✓ Avalanche photodiode



PN junction photodiode

- If the light energy applied to the photodiode is greater than the band-gap of semiconductor material, the valence electrons gain enough energy and break bonding with the parent atom.
- The mechanism of generating electron-hole pair by using light energy is known as the inner





PN junction photodiode

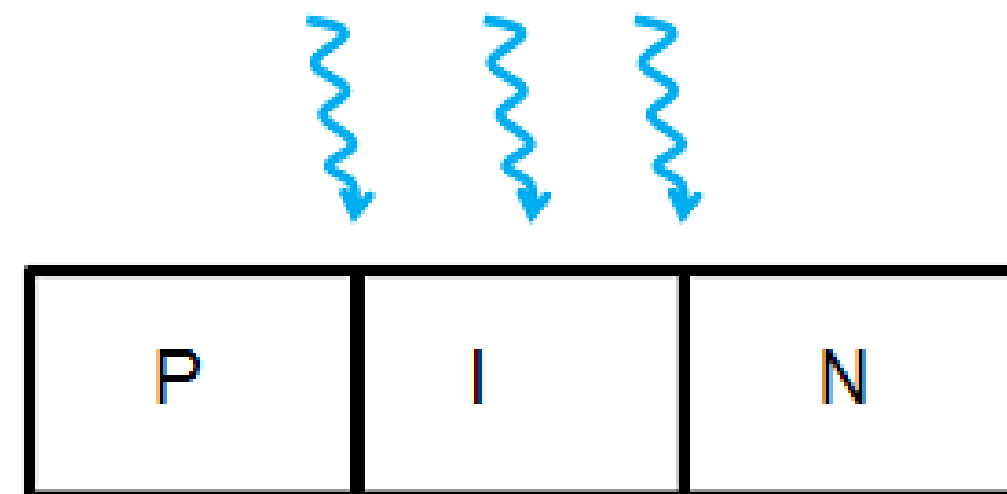


- When no light is applied to the reverse bias photodiode, it carries a small reverse current due to external voltage. This small electric current under the absence of light is called dark current.
- The electric current generated in the photodiode due to the application of light is called photocurrent.
- The total current through the photodiode is the sum of the dark current and the photocurrent.
- The electric current flowing through a photodiode is directly proportional to the incident number of photons.



PIN photodiode

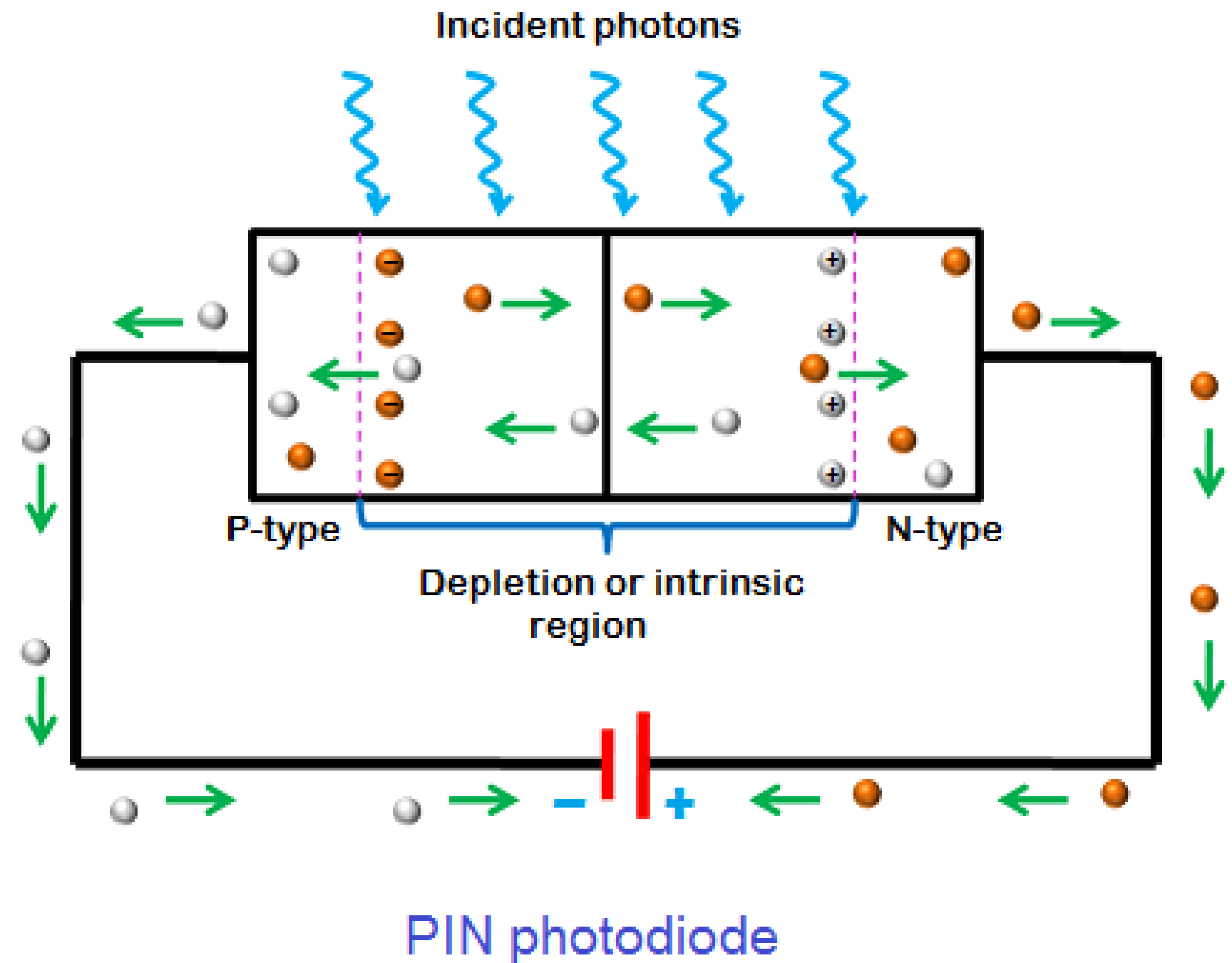
- The operation of PIN photodiode is similar to the PN junction photodiode except that the PIN photodiode is manufactured differently to improve its performance.
- In PIN photodiode, an additional layer called intrinsic semiconductor is placed between the p-type and n-type semiconductor to increase the minority carrier current.





PIN photodiode

- The intrinsic layer is placed between the p region and n region to increase the width of depletion region.
- The p-type and n-type semiconductors are heavily doped.
- In PIN photodiode, the charge carriers generated in the depletion region carry most of the electric current.





PIN photodiode



- When light or photon energy is applied to the PIN diode, most part of the energy is observed by the intrinsic or depletion region because of the wide depletion width. As a result, a large number of electron-hole pairs are generated.
- The separation distance between p region and n region in PIN photodiode is very large because of the wide depletion width. Therefore, PIN photodiode has low capacitance compared to the PN junction photodiode.
- In PIN photodiode, most of the electric current is carried by the charge carriers generated in the depletion region.



Avalanche photodiode



- The operation of avalanche photodiode is similar to the PN junction and PIN photodiode except that a high reverse bias voltage is applied in case of avalanche photodiode to achieve avalanche multiplication.
- In avalanche photodiode, a very high reverse bias voltage supply large amount of energy to the minority carriers (electron-hole pairs). The minority carriers which gains large amount of energy are accelerated to greater velocities.