Fundamentals of Electronics Devices

Unit-5 Lecture-2

Photodiodes

- Often, junction devices can be used to improve the speed of response and sensitivity of detectors of optical or high-energy radiation.
- Two terminal devices designed to respond to photon absorption are called photodiodes.

Introduction

- In unit-4 we identified the current due to drift of minority carriers across a junction as a generation current.
- In particular, carriers generated within the depletion region W are separated by the junction field, electrons being collected in the n region and holes in the p region.

Current and Voltage in an Illuminated Junction

- Also, minority carriers generated thermally within a diffusion length of each side of the junction diffuse to the depletion region and are swept to the other side by the electric field.
- If the junction is uniformly illuminated by the photons with hv > Eg, an odded generation rate gop (EHP/cm^3-s) participates in this current.

Current expression

- If we call the thermally generated current described in unit-4 lth, we can added the optical generation to find the total reverse current with illumination.
- Thus the I-V curve is lowered by an amount proportional to the generation rate.

Optical generation of carriers

- This equation can be considered in two parts
- ➤The current described by the usual diode equation
- >And the current due to optical generation.

 When the device is short circuited (V = 0), the terms from the diode equation cancel, as expected.

Current equation

- However, there is a short-circuit current from n to p equal to Iop.
- Thus the I-V characteristics cross the I-axis at negative values proportional to gop.
- When there is an open circuit across the device, I = 0 and the voltage V = V_{oc}.