Fundamentals of Electronics Devices

Unit-3

Lecture-2

Equilibrium Conditions

- In this unit we wish to develop both a useful mathematical description of the p-n junction and a strong qualitative understanding of its properties.
- There must be some compromise in these two goals, since a complete mathematical treatment would obscure the essentially simple physical features of junction operation, while a completely qualitative description would not be useful in making calculations.

Mathematical approach

- The approach, therefore, will be to describe the junction mathematically while neglecting small effects which add little to the basic solution.
- The mathematics of p-n junctions is greatly simplified for the case of the step junction, which has uniform p doping on one side of a sharp junction and uniform n doping on the other side.

Modelling

- This model represents epitaxial junctions quite well; diffused or implanted junctions, however, are actually graded (N_d – N_a varies over a significant distance on either side of the junction).

Introduction

- After the basic ideas of junction theory are explored for the step junction, we can make the appropriate corrections to extend the theory to the graded junction.
- In these discussions we shall assume one-dimensional current flow in samples of uniform cross-sectional area.

Step junction property

- In this lecture we investigate the properties of the step junction at equilibrium (i.e., with no external excitation and no net currents flowing in the device).
- We shall find that the difference in doping on each side of the junction causes a potential difference between the two types of material.

- This is a reasonable result, since we would expect some charge transfer because of diffusion between the p material (many holes) and n material (many electrons).
- In addition, we shall find that there are four components of current which flow across the junction due to the drift and diffusion of electrons and holes.