Assignment Semiconductors

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1) **Difference between n-type and p-type semiconductor materials**
   - **n-type semiconductor**: An n-type semiconductor is formed by adding a small amount of **pentavalent (donor) impurity,** such as phosphorus or arsenic, to pure silicon or germanium.
     - It has **extra electrons**.
     - **Electrons** are the **majority charge carriers**, while holes are the minority carriers.
     - It conducts electricity mainly due to the movement of electrons.
   - **p-type semiconductor**: A p-type semiconductor is formed by adding a **trivalent (acceptor) impurity** such as boron or aluminum.
     - It has a **deficiency of electrons**, creating **holes**.
     - **Holes** are the **majority charge carriers**, while electrons are the minority carriers.
     - It conducts electricity mainly due to the movement of holes.

2) **Forward bias and reverse bias conditions of a p–n junction diode and their effect on current**

- **Forward bias**: A p–n junction diode is said to be forward biased when the **p-side is connected to the positive terminal** of the battery and the **n-side is connected to the negative terminal**.

  This reduces the width of the depletion region, allowing charge carriers (electrons and holes) to cross the junction. This makes **current flow easily** through the diode.

- **Reverse bias**: A p–n junction diode is reverse-biased when the **p-side is connected to the negative terminal** and the **n-side is connected to the positive terminal**.

  This increases the width of the depletion region and blocks the movement of charge carriers.
  This results in **almost no current flows**, except for a very small leakage current.

3. Meaning of the word “ideal” when applied to a device or system: When a device or system is described as **ideal**, it means that it is a **perfect, theoretical model** used for understanding and analysis.