Doped Semiconductors

- Pure semiconductors are insulating
  - Valence levels are filled and can’t conduct
  - Conduction levels are empty and can’t conduct
- Impure semiconductors can be conducting
  - Extra valence levels → valence band conduction
  - Extra electrons → conduction band conduction

p-Type Semiconductors

- Substitute atoms with more empty orbitals
- Extra, empty valence levels
- Electrons can move through valence levels

n-Type Semiconductors

- Substitute atoms with more filled orbitals
- Extra, full conduction levels
- Electrons can move through conduction levels

pn-Junction (before)

- Before p-type meets n-type:
  - Each material can conduct electricity
  - Each material is electrically neutral everywhere

pn-Junction (after)

- After p-type meets n-type:
  - Insulating depletion region appears at junction
  - Depletion region is electrically polarized

Forward Conduction

- A diode conducts when electrons arrive at the n-type end and leave at the p-type end
- Depletion region shrinks
Reverse Conduction

- A diode doesn’t conduct when electrons arrive at the n-type end and leave at the p-type end
- Depletion region enlarges

MOSFET Transistor Off

- Two back-to-back pn-Junctions
- Normally does not conduct electricity at all

MOSFET Transistor On

- Gate charge can change the channel type
- Entire device becomes one type and conducts