EEE-2103: Electronic Devices and Circuits

Dept. of Computer Science and Engineering
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Course Outline

Syllabus:

Semiconductors: properties, bonds and types
pn junction diode: formation, properties and characteristics
Special Purpose Diodes: LED and Zener diode
Diode Applications: rectifiers, filters, clipping/clamping ckts, voltage regulator ckts

BJT: npn/pnp transistors, characteristics (CB/CE/CC), load line analysis
BJT Biasing: transistor parameters, stability factor, methods, analysis and design
Single Stage Amplifier: amplifier ckts, equivalent ckts, load line analysis, gain, classification

FET: classification, construction, operation and characteristics of JFET and MOSFET, transfer characteristics and DC biasing of JFET.

Power Electronics: operations, characteristics and applications of SCR, TRIAC and DIAC

Feedback Techniques and Op-amps: negative and positive feedback, inverting, non-inverting, differentiators, summing amplifiers

Oscillators: theory and characteristics
Introduction to IC fabrication.

Course Outline

Reference Books:

(1) Electronic Devices and Circuits; David A. Bell
(2) Electronic Devices and Circuit Theory; R. Boylestad and L. Nashelsky
(3) Electronic Devices; Thomas L. Floyd

Class Hour:

Sunday: 08.30am ~ 10.00am
Monday: 08.30am ~ 10.00am

Place:

Room #413, Dept. of CSE, DU

Incourse Exam:

Only one compulsory incourse exam will be taken.
6 short answer type questions will be given from any consecutive 6 lectures.
Students have to answer any 5 questions in 1 hour (marks- $5 \times 5 = 25$).

Course Outline

Notices:

Available at- sazzadmsi.webnode.com
Class code @google-classroom- **6huewmh**

Marks Distribution:

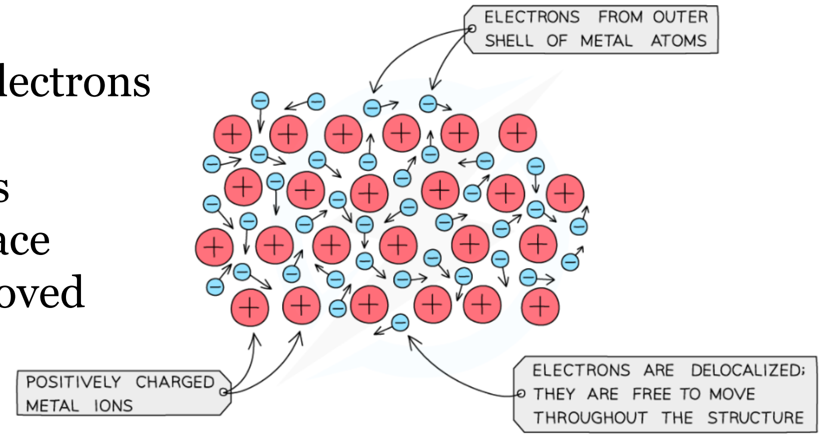
(1) Attendance/Assignment: 5
(2) Incourse: 25
(3) Final: 70 (answer any 5 out of 7; $5 \times 14 = 70$; 3 hours)

Conductors, Semiconductors and Insulators

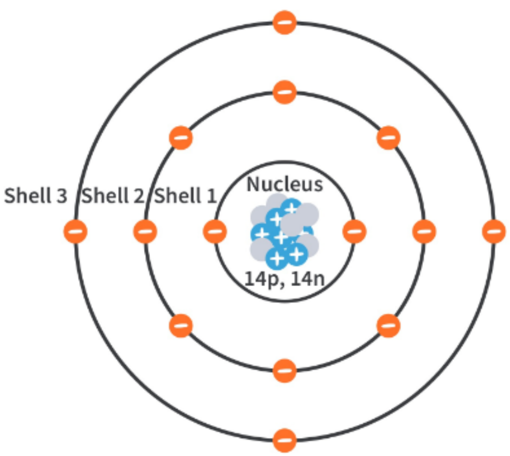
Bonding forces between atoms:

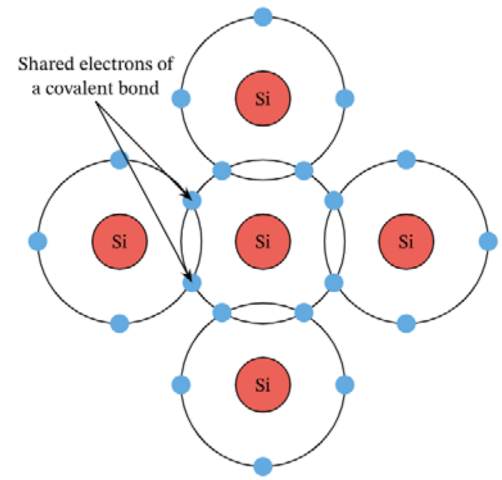
Atoms bond themselves → what happens to outer-shell electrons

1) Metallic bonding → easily detached valence electrons
electron gas drifting about in space
voltage → electrons are easily moved
create current flow
Na, Cu, Fe, Al, Au



2) Covalent bonding → outer shell – 4 electrons, 4 holes
valence shell electrons fill valence holes of 4 adjacent atoms
no holes, no electrons drifting about
voltage → weakly attached electrons break away
create current flow
Si, Ge, GaAs, InP





Conductors, Semiconductors and Insulators

Bonding forces between atoms:

3) Ionic bonding →

insulating materials →

rubber, glass, ceramic, wood

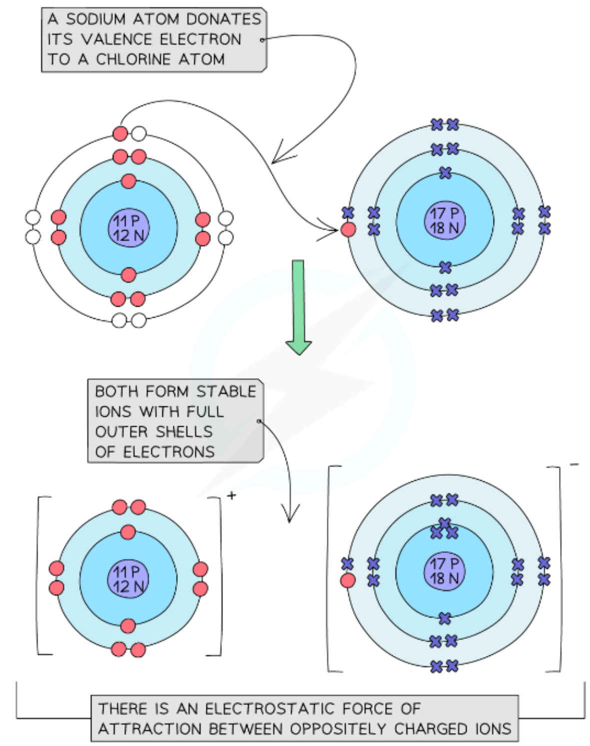
i) covalent bonding =

strongly attached valence shell electrons

ii) ionized atoms =

free outer-shell electrons are accepted by nearby atoms

no free electrons to create current



Metallic bond → Conductors

Covalent bond → Semiconductors

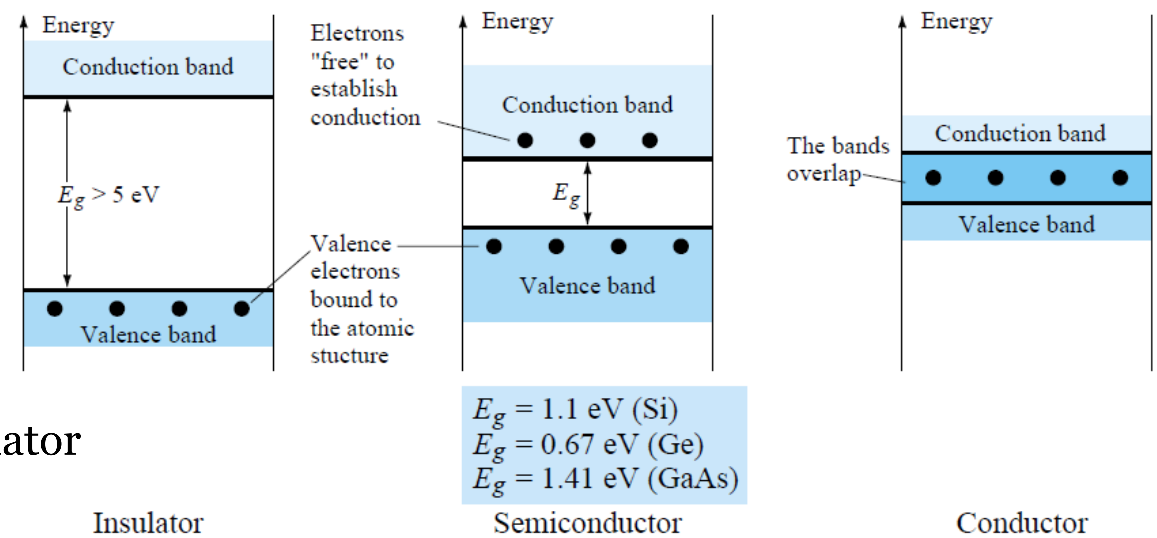
Ionic bond → Insulators

Conductors, Semiconductors and Insulators

Energy bands in different materials:

1) Insulators (10^{14} Ω):

Empty conduction band
Filled valence band
Wide forbidden gap



2) Semiconductors (10 Ω):

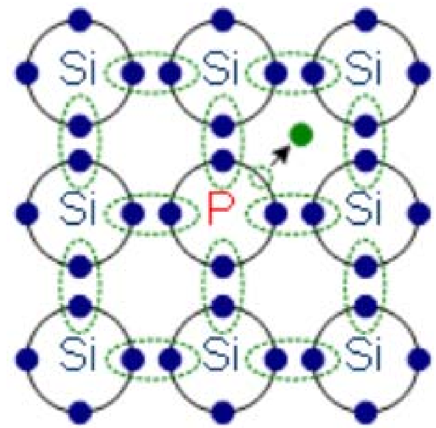
narrower forbidden gap
At absolute zero →
semiconductor = insulator
At room temperature or
Applied voltage →
electron movement in conduction band and
hole transfer in valence band

3) Conductors (10^{-6} Ω):

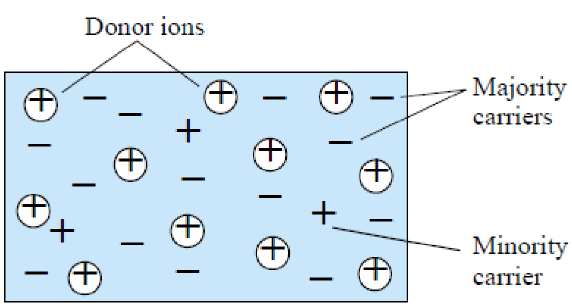
no forbidden gap
valence and conduction energy bands overlap

n-Type and *p*-Type Semiconductors

Doping:
Pure semiconductor = intrinsic material [Si, Ge, GaAs, InP]
Intrinsic material + Impurity atoms →
improve conductivity
doping = extrinsic material
donor doping = generates free conduction band electrons
acceptor doping = generates valence band holes

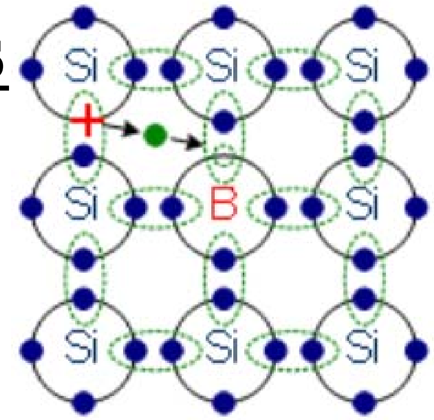


n-type material:
Semiconductor atoms = 4 electrons + 4 holes
Impurity atoms = 5 electrons + 3 holes = pentavalent atoms
P, As, Sb, Bi
Semiconductor atoms + Impurity atoms = additional free electrons donated
n-type material
electrically neutral



Conduction = electron motion
Majority charge carriers = electrons
Minority charge carriers = holes

n-Type and *p*-Type Semiconductors



p-type material:

Semiconductor atoms = 4 electrons + 4 holes

Impurity atoms = 3 electrons + 5 holes = trivalent atoms

B, Al, Ga

Semiconductor atoms + Impurity atoms = additional hole to accept electron

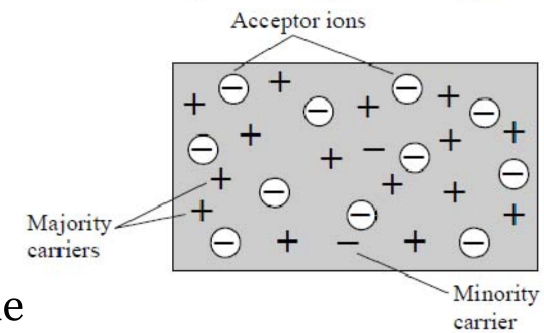
p-type material

electrically neutral

Conduction = hole transfer

Majority charge carriers = holes

Minority charge carriers = electrons



Electron-hole pair generation → energy creates pair of electron and hole

Electron-hole pair recombination → electron falls into hole