

Department of Materials Science and Engineering
MSE 466 Materials Science & Engineering
Physical Properties of Materials (4 credits)

Catalog description: Introduction to elementary solid-state concepts in materials. Atom bonding, statistical mechanics, free electrons and band theories. Applications of principles to conduction in metals insulators, and semiconductors. Optical and magnetic properties in solids.

Prerequisites: MSE-314

Textbook: R. Hummel, Electronic Properties of Materials,
Second edition, Springer-Verlag, NY

Course packet by F.S.Ohuchi

Instructor: Professor Fumio S. Ohuchi
311 Roberts Hall
Tel: (206) 685-8272
FAX: (206) 543-3100
e-mail: ohuchi@u.washington.edu

Course Objectives:

At the end of this course, the student will be able to:

1. Predict general trends of the materials properties based on the electron configuration, type of bonding, and arrangement of the elements in the periodic table.
2. Describe how the energy bands are formed in solid materials, and be able to read specific natures of the energy band diagram (Fermi energy level, band width, band gap, density of state, etc.), and describe the basic electronic properties of materials.
3. Estimate approximate values of the electrical conductivity for different types of materials. Be able to tell the order of magnitudes of electrical conductivity of typical materials, such as quartz, Teflon, intrinsic Si, doped Si, Cu, Au, diamond, graphite, etc.
4. Name important semiconductors belonging to a group IV, a group III-V, a group of II-VI, and describe the differences in terms of chemical bonding, crystallographic structure, and electronic/optical properties. Describe the practical utility of each.
5. Describe the temperature dependence of the number of carriers, mobility and electrical conductivity for typical intrinsic and extrinsic semiconductors.

6. Describe how the electrical conduction occurs in polymers. Outline how to improve the electrical conductivity of polymer
7. Describe how the metal-semiconductor and the p-n junction work. Describe the design concept for semiconductor junction fabrication.
8. Calculate the wavelength of light emitted from given semiconductors, and describe the specific processes involved in the light emission of selected materials .

Class Schedule: Three-one hour class room sessions weekly
 One-one hour quiz session weekly

Contribution of course to meeting the professional component:

This course introduces electronic theory of materials, and their applications to microelectronics and optoelectronics. It provides the background the students need for further study in electronic and optical materials and devices.

Contribution of course to program objectives

This course provides students with in-depth knowledge about the electronic processes in materials. It provides applications of science and technology to specific systems and relates structure/properties of electronic and optical materials to the basic science of these materials. The applications to specific material systems result in strengthened degree programs.

Prepared by: F. S. Ohuchi, Professor, April, 2000