

Course Syllabus
Southeast Missouri State University

Department of Physics
Title of Course: Materials Science

Course No. EP462/EP503
Revision: Spring 1999

I. Catalog Description

The solid state; structure of solids; mechanical, chemical, thermal, electrical, magnetic and optical properties of materials; behavior of materials in engineering applications. Spring of odd years only. Prerequisites: PH231/PH031; MA245. (3)

II. Pre-requisites

PH231/PH031 - General Physics II
MA245 - Vector Calculus

III. Objectives:

- A. To provide students with the knowledge of the basic properties of materials that includes metals, ceramics, polymers, and composites.
- B. To provide students with the knowledge of the applications of different types of materials.
- C. To acquaint students with the local industries and their manufacturing processes.
- D. To acquaint students with design experiments that will be used to test mechanical, electrical, chemical, and thermal, properties of materials.

IV. Course Expectations:

- A. All Students
 - 1. Come to the class regularly, participate in discussions which is a very important component of this course, participate in homework problem solving and perform satisfactorily in examinations.
 - 2. Prepare a topic related to the materials science and present it in front of other students in the class.
- B. Graduate Students
 - 1. To design an experiment that will be used to test chemical, mechanical, electrical or thermal properties of materials.
 - 2. To write a journal style paper on the chosen design experiment.

V. Course Outline (Hours)

- A. Introduction to materials (2)
 - 1. Materials Science and Engineering
 - 2. Types of Materials
 - 3. Competition Among materials
 - 4. Future Trends in Materials

- B. Atomic Structure and Bonding (3)
 - 1. The Electronic Structure of Atoms
 - 2. Ionic Bonding
 - 3. Metallic Bonding
 - 4. Secondary Bonding

- C. Crystal Structures and Crystal Geometry (6)
 - 1. The Space Lattice and Unit Cells
 - 2. Principal Metallic Crystal Structures
 - 3. Atom Positions in Cubic Unit Cells
 - 4. Directions in Cubic Unit Cells
 - 5. Miller Indices for Crystallographic Planes in Cubic Unit Cells
 - 6. Polymorphism or Allotropy
 - 7. Crystal Structure Analysis

- D. Solidification, Crystalline Imperfection, and Diffusion in Solids (6)
 - 1. Solidification of Metals and Crystals
 - 2. Crystalline Imperfection
 - 3. Atomic Diffusion in Solids
 - 4. Effect of Temperature on Diffusion in Solids

- E. Mechanical Properties of Metals (5)
 - 1. The Processing of Metals and Alloys
 - 2. Stress and Strain in Metals
 - 3. Plastic Deformation of Metal Single Crystals
 - 4. Plastic Deformation of Polycrystalline Metals
 - 5. Fracture of Metals
 - 6. Fatigue of Metals

- F. Polymers (5)
 - 1. Polymerization Reactions
 - 2. Processing of Plastic Materials
 - 3. General Purpose and Engineering Thermoplastics
 - 4. Thermosetting Plastics and Elastomers

- G. Ceramic Materials (4)

1. Simple Ceramic Crystal Structures
 2. Processing of Ceramics
 3. Electrical Properties of Ceramics
 4. Mechanical Properties of Ceramics
- H. Composite Materials (3)
1. Fibers for Reinforced Plastic Composite Materials
 2. Concrete
 3. Asphalt and Wood
 4. Metal-Matrix and Ceramic-Matrix Composites
- I. Electrical Properties of Materials (4)
1. Electric Conduction in Metals
 2. Intrinsic and Extrinsic Semiconductors
 3. Semiconductor Devices
 4. Superconductors
- J. Four Examinations (4)
- K. Local Company Visits (3)

Total Hours During a Semester: 45

VI. Textbooks and Other Required Material

Foundations of Material Science and Engineering by William F. Smith (McGraw-Hill, 2nd edition, 1993)

VII. Basis for Student Evaluation

- A. Undergraduate Students:
1. Pop Quiz and Homework - 12%
 2. Exams I - III, 16% each - 48%
 3. Final Examination - 20%
 4. Class Presentation - 20%
- Total - 100%**
- B. Graduate Students:
1. Pop Quiz and Homework - 10%
 2. Exams I - III, 12% each - 36%
 3. Final Examination - 14%
 4. Class Presentation - 20%
 5. Term Paper - 10%
 6. Design Experiment - 10%
- Total - 100%**