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Crystal Chemistry, R.C. Evans, Cambridge University Press, 1965
Structure-Property Relations, R.E. Newnham, Springer-Verlag, 1975
Introduction to Ceramics, W.D. Kingery
Crystallography and Crystal Chemistry, Donald Bloss

Instructor: A. Safari, Professor
Office: Center for Ceramic Research – Rm. 118 Telephone: 445-4367
Email: safari@rci.rutgers.edu

TAs: William Simon or Nader Marandian Hagh
Office: Center for Ceramic Research – Rm. 120 Telephone: 445-5567
Email: wksimon@eden.rutgers.edu or nmhagh@rci.rutgers.edu

Goals:
1) Identify important minerals and materials by their name, chemical formula, structure and properties
2) Describe the crystal structure of materials and build their atomic models.
3) Understand the origins of physical and chemical properties, in bonding and structure.
4) Develop an understanding of the engineering applications of materials, based on their structure and properties.

Project: A term paper on the crystal structure and properties of one important compound/mineral.

Grading: Lecture Quiz 20 points each (four)
Lab Quiz 10 points each (10)
Mid-term 100 points
Term paper/presentation 40 points
Final 100 points

Relationship to Program Objectives:
This course contributes to the program objectives, 1, 2, 3, and 5 outlined in the undergraduate handbook. Contributions to the general ABET proficiencies (a), (c), (e), (g), (j), and (l) are made. Components (a), (c), and (e) are addressed through course work, and in class laboratory assignments, while components (g) and (j) are addressed through a written term paper and accompanying presentation.

Lecture Topics:
Review of the periodic system emphasizing elements, compounds and minerals of interest to Materials Engineers.

Atomic Structure: The Rutherford-Bohr Theory, Electronic Structure

Sizes of atoms and ions: Ionic radii, covalent radii, metallic radii, Van der Waals radii, trends and relations.

Review of chemical bonding: Ionic, covalent, metallic, and Van der Waals. Relationship to melting points, electrical conductivity, and hardness.

Pauling’s rules and prediction of structures. Coordination numbers, 8-n rule for covalent bonds, and applications to oxides.

Crystal system and unit cells: Theoretical density, hardness, and optical activity. Miller indices and zone axes.

Symmetry elements, point group and crystal classes, enumeration of the 32 point groups and crystal classes.

Primitive Structures, Polytypism, Layered Structures and Clays

Bonding rules applied to glass structure and surface properties of clays.

Network Structures: Classification of Silical structure, Silicates, Fused Silica and Polymers

Structure - Property Relations

Atomic Model Building – Lab Class

Lab 1 Common oxide structures: Rocksalt and Fluorite, CsCl

Lab 2 Common oxide structures: Diamond, Zinc blend and Wurtzite Structures
Lab 3  Metal Structures: Hexagonal Close Packed, Body Centered Cubic
Lab 4  Metal Structures: Face Centered Cubic, Dislocations
Lab 5  Rutile, Graphite, and Boron Nitride Structure
Lab 6  Polymers: Polyethylene, Nylon, and polyvinyl chloride
Lab 7  Corundum Structures
Lab 8  Perovskite and Superconductor Structures
Lab 9  Spinel and Alumina Structures
Lab 10  Cristoballite ans Tridymite structures
Lab 11  Beryl and Feldspir Structures
Lab 12  Zoelite Structure