

COURSE TITLE:

Physical Chemistry of the Solid State

CALENDAR ENTRY:

CHEM 410. (3) *Physical Chemistry of the Solid State* — Introduction to the theory of electrons in solids; bands and zones. Absorption of light and excitons. Vacancies, interstitials, electronic defects and dislocations and their roles in chemical reactivity. *Prerequisites:* CHEM 202 and (CHEM 201 or CHEM 205). [0-0-0; 3-0-0]

TIME AND PLACE: Lectures: Chemistry C126 - Mon, Wed, & Fri 11:00 AM -11:50 AM. Tutorials: TBA

WEB SITE: <http://www.chem.ubc.ca/courseware/courseware.shtml> - see Chem410 link

INSTRUCTOR: W. Andrew MacFarlane
OFFICE: Ampel 317: 822-6866
LABORATORY: TRIUMF: 222-1047, ext 6713
OFFICE HOURS: by appointment

MARKING:

ITEM	MARKS
Assignments	30
Midterm Exam	20
Final Exam	50
TOTAL	100

TEXTBOOK: none

REFERENCES: *Basic Solid State Chemistry* (Wiley, NY, 1999) by A.R. West
Solid State Chemistry (CRC, NY, 2005) by L.E. Smart and E.A. Moore
Introduction to Solid State Physics (Wiley, NY, 2004) by C. Kittel
The Electronic Structure and Chemistry of Solids (Oxford, 1987) by P.A. Cox
Electronic Structure and the Properties of Solids (The Physics of the Chemical Bond) (Freeman, SF, 1980) by W.A. Harrison

CHEM 410 (Spring 2006) General Outline

I Introduction

- General features of the solid state
- Classification of solids by order and cohesion

II The Structure of Crystals

- General crystal structures: Bravais Lattice, Basis, Unit Cells
- Symmetry Classifications
- Common crystal structures
- Diffraction and Crystallography

III Electronic Structure and Bonding in Crystals

- Molecular Crystals: Van der Waals forces, Lennard-Jones Potential, Structures
- Ionic Crystals: Madelung energies, optical absorption
- The Free Electron Model of Metals
- Band Theory: Bloch Waves, Brillouin Zones, Band Structure Diagrams
- LCAO approximation
- Fermi distribution function, the Chemical Potential for electrons

IV Defects in Crystals

- Intrinsic defects: point defects (vacancies, interstitials), dislocations, surfaces
- Extrinsic defects
- Dependence of properties on defects
- Migration of defects: diffusion
- Detecting defects

V Semiconductors

- Band Structure, Charge Carriers, Conductivity, Mobility, Effective Mass
- Semiconductor Devices

VI Optional Topics (as time permits)

- Magnetism in solids
- Ionic Conduction: Solid State Batteries and Fuel Cells
- Phase Transitions and Phase Diagrams for Solids