



SOLID STATE CHEMISTRY

PROF. MADHAV RANGANATHAN

Department of Chemistry
IIT Kanpur



TYPE OF COURSE : New | UG/PG

COURSE DURATION : 12 weeks (28 Jan'19 - 19 Apr'19)

EXAM DATE : 28 Apr 2019

PRE-REQUISITES : Basic physical chemistry including thermodynamics, kinetics and quantum chemistry, basic vector analysis and coordinate geometry

COURSE OUTLINE :

This course will go over the basics of solid state materials, primarily crystalline solids and describe features and properties of certain specific materials. Some of the basic topics included will be thermodynamics of solids, unit cells, lattice, crystals, symmetry, symmetry groups, defects, x-ray diffraction, microscopy. Following this, the discussion will move to specific materials like binary alloys, oxides, nitrides and sulphides, perovskites, spinels. The course will conclude with a discussion of band theory, band structure, electronic and optical properties.

ABOUT INSTRUCTOR :

Prof. Madhav Ranganathan has been a faculty in the Department of Chemistry, IIT Kanpur since 2007. His research interests are statistical mechanics of crystal growth and theoretical biophysics. His main teaching interests are in Physical Chemistry, especially more theoretically inclined courses. He has taught several courses at IIT Kanpur at undergraduate, masters and doctorate levels. He has taught Mathematics for Chemistry at IIT Kanpur several times and this has influenced the material for this course.

COURSE PLAN :

- Week 01** : Crystalline and amorphous solids, thermodynamics of solids, crystallization kinetics, nucleation.
- Week 02** : Unit Cell, Conventional unit cell, primitive unit cell, lattice and basis, Bravais lattices, lattice translation vectors.
- Week 03** : Symmetry in crystals, rotations, reflections, inversions, rotoinversions. Schonflies and Hermann-Mauguin notations.
- Week 04** : Translational symmetry elements, glide plane, screw axis, relevance of symmetries.
- Week 05** : Crystal systems, point groups, space groups.
- Week 06** : Group notations, Schonflies notations, Hermann-Mauguin notations.
- Week 07** : Coordination number, defects and voids in crystals, Schottky and Frenkel defects, interstitials.
- Week 08** : Lattice planes, Miller indices, X-ray diffraction, Bragg's law, X-ray diffraction, indexing of peaks
- Week 09** : Powder X-ray diffractometers, single crystal X-ray diffractometers, X-ray crystallography, electron density maps, electron microscopy techniques.
- Week 10** : Crystal structures of elements, alloys, binary compounds, nitrides, sulphides, perovskites, spinels.
- Week 11** : Electronic structure of solids, origin of bands, band structure, density of states.
- Week 12** : Band structure and electrical conductivity, band gap, optical properties.