MCYF 305 Solid State Chemistry (3-0-0) (3 credits)

Module I

Chemical crystallography (14 hours)

Introduction, Space lattice, Crystal point groups, space group (working knowledge), Stereographic projections, Packing in solids, Crystal structures of representative systems, Silicates and Zeolites, Cements, Glasses, Quasicrystals, Nanostructures.

Bonding in solids and Crystal energetics

Crystal classifications, Madelung constant and Lattice energy.

Module II (12 hours)

Electronic properties and Band theory of solids

Free electron model, Metals, semiconductors and insulators, doped semiconductors
Solid state ionics.

Defects, Nonstoichiometry and Diffusion

Point defects, Dislocations, Extended defects, Clusters and aggregates, Color centres, Non-stoichiometry of compounds, Diffusion mechanisms, Fick's law, Kirkenall effect.

Phase transitions

Critical phenomena, variety of phase transitions (Ordered- disorder, Martensite-austenite, Spinoidal decompositions etc), Liquid crystals, Structure-property relations (magnetic, electrical, superconductivity, optical and thermal).

Module III

Preparative and characterization techniques (14 hours)

Powder synthesis by conventional and modern chemical methods, Reactivity of solids, Decomposition mechanisms, Powder processing (sintering and diffusion processes), Tailoring of solids, Special methods for single crystal growth and thin films depositions.

Characterization techniques (working knowledge) for solids

X-ray diffraction, Electron microscopy (SEM, TEM, AFM), Spectroscopic techniques (Mossbauer, IR, UV-VIS) and Physical property measurement techniques (Magnetic moments-VSM /SQUID, Electrical resistivity – Two / Four probe methods and thermal conductivity, Optical band gap, XPS, XAS).

Recommended books:

1. A. R. West, Solid State chemistry and its applications, 2nd edition, John Wiley & Sons,.
2. L. Smart and E. Moore, Solid State chemistry: An Introduction, 4th edition, Chapman and Hall.
3. A. K. Cheetham and P. Day, Solid state chemistry compounds, Clarendon Press, Oxford 1992.
4. C. N. R. Rao and J. Gopalkrishanan, New directions in solid state chemistry, Cambridge Univ. Press 1997.
5. S.E. Dann, Reactions and Characterization of Solids, , ISBN 0-471-22481-2
6. A.R. West , Basic Solid State Chemistry, Wiley, 3rd edition, 2012
7. Christopher Hammondhy, The Basics of Crystallography and Diffraction (International Union of Crystallography Texts on Crystallograp)**, Wiley** 2009