MANGALORE UNIVERSITY

DEPARTMENT OF CHEMISTRY

M.Sc. CHEMISTRY

CH H 503: SOLID STATE CHEMISTRY

COURSE OUTCOME:

- It is an interdisciplinary course falling at the boundary of physics and chemistry.
- It is aimed at understanding the properties of solids and their possible applications in materials science as superconductors, semiconductors, liquid crystal materials and as magnetic materials.
- Importance has been given to the methods of preparation of solids, understanding the structure-property relationships and their possible applications.
- Importance has also been given to the advanced topics of nanomaterials.

UNIT–I:[15hours]

Surface morphology: Structure of solid surfaces and adsorbed layers. Mechanism of surface reactions. 3hrs.

Crystal Defects and Non-Stoichiometry: Imperfections and defects in crystals. Vacancy, Schottky and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, colour centres, non-stoichiometry and defects–Structures of UO2, FeO and TiO2. 4hrs.

Solid State Reactions: General Principles, Wagner's theory. Order- disorder transitions in solids- Bragg- William's theory Mechanism of diffusion, Kirkendall effect. 3 hrs

Preparative Methods: Ceramic, sol-gel, precursor and chemical vapour deposition (CVD) methods. Nucleation & crystal growth techniques-pulling, zoning, flame fusion & skull melting. Basic methods of preparation of thin films. 5 hrs

UNIT–II:[15hours]

Electronic Properties and Band Theory: Free electron theory to band theory of solids, electrical conductivity, Hall effect. Metals, Insulators and Semiconductors. Intrinsic and extrinsic semiconductors, hopping semiconductors. Metal – semiconductor and p-n junctions. 6 hrs

Magnetic properties: Classification of magnetic materials–dia, para, ferro, ferri, antiferro & antiferri magnetic types Langevin diamagnetism. Selected magnetic materials such as spinels & garnets. 4hrs **Ionic Conductors:** Types of ionic conductors, mechanism of ionic

conduction, diffusion superionic conductors; phase transitions and mechanism of conduction in superionic conductors, examples-□-alumina, AgI, halide and oxide ion conductors 5 hrs

UNIT - III: [15 Hours]

Superconductivity: Meissner effects; Types I and II superconductors, Features of super-conductors, isotope effect, high Tc materials. Basics of low temperature superconductivity. 5hrs.

Liquid Crystals: Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smecticmeso phases; smectic – nematic transition and clearing temperature- homeotropic, planar and schlieren textures, twisted nematics chiral nematics, molecular arrangements in smectic A & C phases. Optical properties of liquid crystals 5hrs

Nanomaterials: Introduction–importance and characterization of nanomaterials–stability of nanoparticles In solutions – synthesis of metal nanomaterials: Physical methods (Laser Ablation, Evaporation, sputtering and solvated metal dispersion) chemical methods (Thermolysis, Sonochemical approach, reduction of metal ions by hydrogen and methanol) 5hrs.

REFERENCES:

1. D. K. Chakrabarty, Solid state chemistry (New Age) 1996.
2. H.V. Keer, Principles of the solid state (Wiley Eastern) 1993.
3. A.R. West, Solid state chemistry and its applications (Wiley) 1984.
4. L. Smart and E. Moore, Solid State Chemistry –An Introduction (Chapman &Hall) 1992.
5. L. Azaroff, An Introduction to Solids (Mc Graw Hill).
6. V. Raghavan, Material science and Engineering (3rd Ed), (Prentice Hall India) 1993.
7. Thermotropic Liquid Crystals, Ed. G.W. Gray, Wiley.
8. S. Chandrasekhar, Liquid Crystals, Cambridge University Press (2nded), 1994.
9. Chemical Kinetics, K. J. Laidler, Pearson Education, Anand Sons (India) 3rd edition (2008)
10. Physical Chemistry at surfaces, 6th ed., A.W Adamson and A P Gast, John Wiley, Canada, 1997.
11. C.P. Poole and F.K. Owens Introduction to Nanotechnology, (2004).
12. T. Pradeep, Nano: The Essential, Tata McGraw Hill Publishing Company Ld., New Delhi, (2008).