MANGALORE UNIVERSITY

DEPARTMENT OF CHEMISTRY

M.Sc. APPLIED CHEMISTRY

AC H 553: CHEMISTRY OF SOLID STATE AND NANO MATERIALS

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.
- Preparation of nanosized materials and their potential applications in nanotechnology will be discussed.
- This course also contains topics of supramolecular chemistry and pharmacokinetics.

UNIT-I: **[15 Hours]**

Surface morphology: Structure of solid surfaces and adsorbed layers. Mechanism of surface reactions. Study of surface morphology (LEED. AFS and SEM). **Crystal Defects and Non-Stoichiometry:** Perfect and imperfect crystals, intrinsic and extrinsic defects- point, line and plane defects. Vacancy, Schottky and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, colour centres, non-stoichiometry and defects – Structures of UO_2, FeO and TiO. **Solid State Reactions**: General Principles, Wagner's theory. Order- disorder transitions in solids- Bragg- William's theory Mechanism of diffusion, Kirkendall effect **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.

UNIT – II: **[15 Hours]**

Ionic Conductors: Types of ionic conductors, mechanism of ionic conduction, diffusion superionic conductors; phase transitions and mechanism of conduction in superionic conductors, examples-β-alumina, AgI, halide and oxide ion conductors. 4 hrs

Superconductivity: Meisner effects; Types I and II superconductors, Features of superconductor, isotope effect, high T_c materials. Principle of low temperature superconductivity. 4 hrs

Liquid Crystals: Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smecticmesophases; smectic – nematic transition and clearing temperature- homeotropic, planar &schlieren textures, twisted nematics chiral nematics, molecular arrangements in smectic A and C phases. Optical properties of liquid crystals 4hrs

Magnetic properties: Classification of magnetic materials–dia, para, ferro, ferri, antiferro & antiferri magnetic types Langevin diamagnetism. Selected magnetic materials such as spinels & garnets. 3 hrs

UNIT-III: [15 Hours]

Nano Materials: Introduction, Definition and terminology, consequences of the nanoscale (Nanoparticle, Morphology, Geometric structure, Electronic structure, Optical properties), Nanolayers, Carbon nanotubes, Nanowires, Quantum dots. Nanotechnology and its business applications, Introduction to nanoscale, Potential applications of nanomaterials, Challenges and opportunities scope of nanotechnology, Commercialization scope Nanotechnology research in 21st century, Basic nanotechnology science and chemistry concepts, basic nanostructures , nanocomposites, Thin films, nanofoam, nanoclusters, smart nanostructures, manufacturing techniques of nanomaterials. 7 hrs.

Supra Molecular Chemistry Introduction, Cryptands, Cyclophanes, Crown ether, Calixerenes, Cyclodextrines, Molecular self assembly: Catenens and Rotaxenes, Supramolecular reactivity and catalysis, Supramolecular devices. 4hrs

Pharmacokinetics: Introduction, Plasma concentration - time curve, protein binding and drugs, drug dissolution rate, pharmacokinetics applied to one compartment open model (calculation of elimination rate constant & metabolism constant). 4 hrs.

References:

1. Solid state Chemistry, D. K. Chakrabarty (New Age) 1996.
2. Principles of the solid state, H.V. Keer(Wiley Eastern) 1993.
3. Solid state chemistry and its applications, A.R. West (Wiley) 1984.
4. L. Smart and E. Moore, Solid State Chemistry –An Introduction (Chapman &Hall)1992.
1. V. Raghavan, Material science and Engineering (3rd Ed), (Prentice Hall India)1993.
6. Thermotropic Liquid Crystals, Ed. G.W. Gray, Wiley.
7. S. Chandrasekhar, Liquid Crystals, Cambridge University Press (2nded), 1994.
8. Basics of Nano Chemistry, Mamta V Sachdeva, Anmol Publishers, New Dlhi. 2011.
9. Modern heterogeneous Oxidation Catalysis, Wd.NoritakaMiguno, Wiley, Weinheim, 2009
10. Nanoscale materials, Ed-L.M. Liz-Marzan and P.V. Kamath (Kulwer), 2003.
11. Introduction to Nanotechnology, C P Poole and F J Owens (Wiley Intersci), 2006.
12. Introduction to Petrochemicals, Sukumar Maiti (Oxford & IBH, Delhi), 1992.