CHN – 704 (C) Chemistry of Materials

Chemistry of Materials **60 Hrs (2 Hrs/week)**

I Multiphase Materials 5 Hrs

Ferrous alloys; Fe-C phase transformations in ferrous alloys; stainless steels, non-ferrous alloys, properties of ferrous and non-ferrous alloys and their applications.

II Glasses, Ceramics, Composites and Nanomaterials 5 Hrs

Glassy state, glass formers and glass modifiers, applications. Ceramic structures, mechanical properties, clay products. Refractories, characterizations, properties and applications.

Microscopic composites; dispersion-strengthened and particle-reinforced, fibre-reinforced composites, macroscopic composites. Nanocrystalline phase, preparation procedures, special properties, applications.

III Thin Films and Langmuir -Blodgett Films 5 Hrs

Preparation techniques; evaporation/sputtering, chemical processes, MOCVD, sol-gel etc. Langmuir-Blodgett (LB) film, growth techniques, photolithography, properties and applications of thin and LB films.

IV Liquid Crystals 10 Hrs

Mesmorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases; smectic - nematic transition and clearing temperature- homeotropic, planar and schlieren textures, twisted nematics, chiral nematics, molecular arrangement in smectic A and smectic C phases, optical properties of liquid crystals.Dielectric susceptibility and dielectric constants. Lyotropic phases and their description of ordering in liquid crystals.

V Polymeric Materials 5 Hrs

Molecular shape, structure and configuration, crystallinity, stress-strain behaviour, thermal behaviour, polymer types and their applications, conducting and ferro-electric polymers.

VI Ionic Conductors 8 Hrs

Types of ionic conductors, mechanism of ionic conduction, interstitial jumps (Frenkel); vacancy mechanism, diffusion superionic conductors; phase transitions and mechanism of conduction in superionic conductors, examples and applications of ionic conductors.

VII High T_c Materials — 10 Hrs

Defect perovskites, high T_c superconductivity in cuprates, preparation and characterization of 1-2-3 and 2-1-4 materials, normal state properties; anisotropy; temperature dependence of electrical resistance; optical phonon modes, superconducting state; heat capacity; coherence length, elastic constants, position lifetimes, microwave absorption-pairing and multigap structure in high T_c materials, applications of high T_c materials.

VIII Materials for Solid State Devices — 3 Hrs

Rectifiers, transistors, capacitors -IV-V compounds, low-dimensional quantum structures ; optical properties.

IX Organic Solids, Fullerenes, Molecular Devices — 9 Hrs

Conducting organics, organic superconductors, magnetism in organic materials.
Fullerenes –doped, fullerenes as superconductors.
Molecular rectifiers and transistors, artificial photosynthetic devices, optical storage memory and switches -sensors.
Nonlinear optical materials: nonlinear optical effects, second and third order - molecular hyperpolarisability and second order electric susceptibility - materials for second and third harmonic generation.

Books Suggested

1 Solid State Physics, N.W. Ashcroft and N.D. Mermin, Saunders College.

2 Material Science and Engineering, An Introduction, W.D.Callister, Wiley.

3. Principles of the Solid State, H.V. Keer, Wiley Eastern.

4. Materials Science, J.C. Anderson, K.D. Leaver, J.M. Alexander and R.D. Rawlings,ELBS

5. Thermotropic Liquid Crystals, Ed., G.W. Gray, John Wiley.

6. Handbook of Liquid Crystals, Kelker and Hatz, Chemie Verlag.