CHEMISTRY
(Major)
(6th Semester)
Course No.: **CHM-DSC-351**
Advance Materials
Contact Hours: 60; Credits: 04
Full Marks = 100[End Semester Exam (70) Internal Assessment (30)]
Pass Marks = 40 [End Semester Exam (28) Internal Assessment (12)]

Unit-1: Introduction to Nanoscience

Definition of Nano particle, emergence and challenges of nanoscience and nanotechnology, classifications of nanostructured materials: One dimensional, two dimensional and three dimensional nanostructured materials, quantum dots, nanowires, ultrathin films, multilayered materials, metal oxides, semiconductors, new form of carbon (CNT to Graphene), influence of nano over micro/macro, size effects, large surface to volume ratio, surface effects on the properties, applications of nanomaterials.

Unit-2: Nano synthesis

Top down & bottom-up approaches, *Chemical method:* Sol–gel process, Self-assembly process, Electrodeposition, Metal nanocrystals by reduction, Solvothermal synthesis, Photochemical synthesis, Sonochemical synthesis, *Physical method:* Ball milling, Inert gas condensation technique (IGCT), Thermal evaporation,

Greener Nanosynthesis: Greener Synthetic Methods for Functionalized Metal Nanoparticles, Greener Preparations of Inorganic Oxide Nanoparticles, green synthesis of Metal nanoparticles, Nanoparticle characterization methods.

Unit 3: Composite Materials

Overview of composite materials and their need, reinforcements and matrices, types of reinforcements, *Matrix:* Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC), Carbon fibre composites, properties of composites in comparison with standard materials, applications of metal, ceramic and polymer matrix composites.

Unit-4: Liquid Crystals and Surfactant

Liquid crystal: Definition, Classification, Thermotropic and Lyotropic Liquid crystal, example, Vapour pressure-temperature diagram, thermography, LCD and seven segment cell, Molecular arrangement in Nematic, Smectic (SmA, SmC), Cholesteric phases, Discotic liquid crystal, Columnar and discotic nematic phase, Application of liquid crystal.

Surfactant: Amphiphiles, example of cationic and anionic amphiphiles, types of Micelles, formation of Critical Micellar Concentration (CMC), factor effecting CMC, solubilisation and emulsification, emulsifier.

Unit-5: Macromolecules

Definition, example, degree of polymerisation, classification of polymer: a) isotactic b) syndiotactic and c) atactic polymers. Number average and Mass-average molar mass, determination of molar mass by viscometry and osmometry, Polymerization reaction, addition and condensation polymerisation Nylon 66, Dacron, Zieglar-Natta Catalysis, electron and ion conducting polymers.

Reference Books:

- Nanomaterials – An introduction to synthesis, properties and applications, D. Vollath, Wiley-VCH, Second Edition 2013.
- G. Cao, Nanostructures and Nanomaterials – Synthesis, Properties and Applications, Imperial College Press 2006.
- Nanostructured materials: Processing, Properties and Potential Applications, Edited by Carl. C. Koch, Noyes Publications, 2002.
- Composite materials, Sharma S.C., Narosa Publications, 2000.
- Composite materials, Chawla K.K., Springer, New York, 1998.
- Composite materials: Engineering and Science, Mathews F.L. and Rawlings R.D., Chapman and Hall, London, England, 1st edition, 1994.
- Puri, Sharma, Phathania; Principle of Physical Chemistry, 45th Edition, Vishal Publications.
- Peter Atkins, J. D. Paula; Atkins' Physical Chemistry; 8th edition, Oxford University Press.