Rayat Shikshan Sanstha's

Sadguru Gadage Maharaj College, Karad

(Autonomous College)

Department of Chemistry

Certificate Course in Nano science and Applications

Syllabus (w.e.f. 2021-22)

Learning Objectives-

1 . To get knowledge of nano science/nanotechnology- principles and applications
2 . To study of properties of nano scale materials .
3 To apply key concepts in materials science, chemistry, physics, biology, and engineering to the field of nanotechnology.
4. To get knowledge of various synthetic approaches of nano materials.
5. To get knowledge of various characterization techniques of nano materials.
6. To study applications of nano materials.

Learning Outcomes-

1. Students should get knowledge of history and progress of nanotechnology.
2. Students can synthesize nano materials by using different precursors and by different methods.
3. Students would aware about selection of characterization techniques for particular application.
4. Students would identify nanotechnology solutions in various fields.

Theory:

Unit I: Introduction and History of nano science and nanotechnology 15L

A) Introduction**:** History of nanosience and nanotechnology, evolution of nano science. Classification based on size and nature of nano materials. Concept of bulk versus nano materials and dependence of properties on size. Passivated or functionalized Nano materials.

B) Fundamental Properties: Properties of nano particles size shape, surface to volume ratio, band gap. Nano particle morphology Size and shape dependent optical, emission, electronic, photonic, fluorescence, phosphorescence, luminescence, mechanical and catalytical properties. Study of Quantum yield, Stern - Volmer equation, quenching etc.

Unit II: Synthetic methodologies for Nano materials: 15L

Top down and Bottom up approach of synthesis and other necessary methods : Filtration, Centrifugation, Dialysis etc.

Top down methods of synthesis – Mechanical / Ball milling, Laser ablation, Chemical etching, sputtering etc.

Bottom up methods of synthesis- Sol-gel/ Wet chemical method, Spray pyrolysis, Vapour deposition , co precipitation etc.

Hydrothermal / Solvothermal , microwave assisted, Ultra sound / Sonicated, methods of synthesis.

Unit III: Characterization Techniques for Nanoparticles: 15 L

Various spectroscopic techniques like optical spectroscopy. UV visible and Infrared spectroscopy. Raman spectroscopy. X-ray photoelectron spectroscopy.

A) Basic understanding of each technique with special emphasis on characterization at nano scale.

Microscopic techniques – Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), High resolution Transmission Electron Microscopy (HRTEM), Scanning Tunneling Microscopy (STM), Atomic Force Microscopy (AFM),Magnetic Force Microscopy (MFM), Chemical Force Microscopy (CFM),Focused Ion Beam(FIB), Nanolithography etc.

Optical techniques – UV- Visible Spectroscopy, Fluorescence spectrophotometry, FT-IR, Dynamic light Scattering (DLS)

Other methods – BET, Zeta potential, EDX, X- ray diffraction (XRD) etc.

Unit IV: Applications of Nano materials 15L

A) Optical and photo electronic applications - Solar cell, electronic devices, nano sensors, rechargeable batteries etc.

B) Biomedical applications – Study of antimicrobial, antiviral, anticancer properties of nano materials. Applications in drug delivery systems.

C) Environmental applications - Fertilizers and agricultural applications, heavy metal ion detection, nanomaterial based adsorbents for water and wastewater treatment.

D) Catalytic applications – Applications as photo catalyst, Catalyst in organic synthesis etc.

Practical:

List of experiments:

I). Synthesis of various metal and metal oxide nanoparticles. (Each practical is of 5 hours)

1. Hydrothermal method
2. Sol-gel method
3. Co precipitation method
4. Pyrolysis
5. Microwave assisted synthesis
6. Ultra sound assisted synthesis.

II. Characterization of Synthesized Nanoparticles. (Each practical is of 3 hours)

1. Determination of UV –Visible spectra.
2. Determination of FT-IR spectra
3. Determination of Fluorescence spectra

III. Microbial Analysis of synthesized nano particles.

Examination:

1. Theory Examination -50 marks

Nature of question paper – 25 multiple choice questions of 2 marks each)

2. Project work – 50 marks
