GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3143905

Semester – IV

Subject Name: Synthesis of Nanomaterials-I

Type of course: Nano Science and Nanotechnology

Prerequisite: Basic knowledge of inorganic chemistry, physics of materials, and solid-state chemistry up to 12th science level.

Rationale: The objective of this course is to introduce the students to the basics concept of the synthesis of different Nanomaterials using various synthesis techniques.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	4	4	70	30	30	20	150

Sr. No.	Contents	Teaching Hrs.	Module Weightage (%)
1	**INTRODUCTION** 1.1 Classification of Nanostructures 1.2 Nano - Scale Architectures Effects of nano-meter length scale on Physical and Chemical Properties of Materials 1.2.1 Surface area to volume ratio (with example) 1.2.2 Quantum confinement 1.2.3 Physical properties of Nanomaterials 1.2.4 Chemical Properties of Nanomaterials	8	25
2	**FABRICATION METHODS** 2.1 Top down and Bottom-up approaches. 2.2 Classification of top down process. 2.3 Classification of bottom up process. 2.4 Preparation, safety and storage issues 2.5 Forced Hydrolysis and Controlled Release Of Anions 2.5.1 Forced Hydrolysis 2.5.2 Precipitation by Controlled Release of Anions 2.5.3 Nucleation and Growth 2.5.4 Factors Controlling Particle Sizes 2.6 CHEMICAL CO-PRECIPITATION	8	25
3	**SOLID STATE RECACTIONS** 3.1 Reactions between solid compounds 3.2 Solid-Gas Reactions 3.3 Solid-Liquid Reaction 3.4 Intercalation Reactions	8	25
4	**4.1 OXIDE NANOPARTICLES** 4.1.1 General Background of Nano-Oxides 4.1.2 Ceramic Oxide Nanoparticles 4.1.4 Functional Oxide Nanoparticles **4.2 METAL NANOPARTICLES**	8	25

	4.2.1 Background 4.2.2 Precious Metal Nanoparticles 4.2.3 Transition Metal Nanoparticles		

Reference Book:

1. Wang Z. L., Liu Yi Zhang Ze Hand book of nanophase and nanostructure materials (Synthesis-1) (Chapter - 2,3,4,5)
2. Nanostructures and Nano materials-Synthesis, Properties and Applications (Cao, Imperial College Press) (Chapter - 1,2)
3. Nanomaterials: Synthesis, Properties and Applications A.S. Edelstein and R.C. Cammarata (edits), Institute of Physics

Course Outcome

Sr. No.	CO statement	Marks % weightage
CO-1	Students will be able to classify nanomaterials and understand quantum mechanical effects that become prominent at nanoscales	**25**
CO-2	Students will be able to get acquainted with different Nano - Fabrication methods	**25**
CO-3	Students will understand various aspects associated with solid state reactions	**25**
CO-4	Students will get familiarized with various metal and oxide nanoparticles	**25**

Bloom's Taxonomy for Cognitive Domain	Marks % weightage
Recall	40
Comprehension	40
Application	20
Analysis	0
Evaluate	0
Create	0

List of Experiments:

Sr. No	Topics
1.	Synthesis of ZnO (Metal Oxide) nanoparticles by SOL-GEL.
2.	Synthesis of ZnO (Metal Oxide) nanoparticles by Co-precipitation method.
3.	Synthesis of Iron (Metal) nanoparticles.
4.	Synthesis of silver (Metal) Nanoparticles.
5.	Synthesis of nanocrystalline ($BaTiO_3$) ceramics
6.	Understanding of Nanoparticles of a magnetic material are dispersed in a liquid (Nano ferrofluids) using Ferro Fluid Demonstrator Comparison of bulk and Nano iron particles.
7.	Synthesis of Solid-Gas reaction method (Iron to Iron Oxide)