



# GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering  
Subject Code: 3153906  
Synthesis of Nanomaterials-II

## B.E. 5<sup>th</sup> Semester

**Type of course:** Nano science and Nanotechnology

**Prerequisite:** For understand Synthesis of Nanomaterials-II require basic knowledge of inorganic chemistry, physics of materials, and solid state chemistry up to 12<sup>th</sup> science level and Synthesis of Nanomaterials-I.

**Rationale:** To introduce the students to the basics concept of the synthesis of different Nano materials using various synthesis techniques

### Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	4	5	70	30	30	20	150

### Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	<b>PRINCIPLES OF ELECTRON BEAM LITHOGRAPHY:</b>  Physics and chemistry of resists. Processes of interaction electrons with solids, diffusion, secondary electrons, proximity effect and principles of its correction. Alignment of Nano-elements in hybrid nanostructures.	6	20%
2	<b>SELF-ALIGNMENT TECHNIQUES:</b>  Self Narrowing Atomic-beam Pantography. Physical Vapour and Chemical Vapour thin layer Deposition techniques (CVD and PVD). Thickness and deposition rate monitoring. Medium, high, and ultra-high vacuum systems. Ion beam and plasma sources and principles of their operation.	6	20%
3	<b>PHYSICAL VAPOUR AND CHEMICAL VAPOUR THIN LAYER DEPOSITION TECHNIQUES (CVD AND PVD)</b>	5	15%
4	<b>NANOFABRICATION METHODS COMBINING SPM AND E-BEAM LITHOGRAPHY</b>	5	15%
5	<b>VERSATILE SYNTHESIS METHOD RF PLASMA CHEMICAL METHOD:</b>	5	15%



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	Introduction of RF Plasma Chemical Method, Working Principle, and Applications		
6	<b>PULSED LASER DEPOSITION:</b> Introduction, Working Principle Of PLD, Applications Of PLD	5	15%

## Reference Books:

1. **Synthesis of Inorganic Materials** , Ulrich Schubert, Nicola Husing (2<sup>nd</sup> Edition WILE/VCH
2. **Nano scale Science and Technology** Robert Kelsall, Ian Hamley, and Mark Geoghegan (Editors) John-Wiley
3. **Nanomaterials: Synthesis, Properties and Applications** A.S.Edelstein and R.C.Cammarata (edits), Institute of Physics
4. **Nanostructures and Nano materials-Synthesis, Properties and Applications** ( Guozhong Cao, Imperial College Press )
5. **Nanotechnology-Basic Science and Emerging Technologies**

## Course Outcome:

At the end of the semester, the student will be able to:

1. Understand solid state reaction
2. Understand different Nano - Fabrication methods
3. Learn about interesting effects take place at the Nano scale
4. Be able to list a range of industries where Nanotechnology is applied

## Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
Remembrance R Level	Understanding U Level	Application A Level	Analyze N Level	Evaluate E Level
14	19	30	7	-

**Legends: R : Remembrance ; U = Understanding; A = Application and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table

Sr. No	Topics
1	Synthesis of TiO <sub>2</sub> nanoparticles



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2	Green Synthesis of Metallic Nanoparticles
3	synthesis of magnetic nanoparticles
4	synthesis of semiconducting nanoparticles
5	synthesis of nanoparticles by Co-precipitation method
6	Synthesis of nanoparticles using colloidal methods
7	Synthesis of nanoparticles using wet chemical methods
8	Synthesis of nanoparticles using hydrothermal methods