ST. ALOYSIUS COLLEGE(AUTONOMOUS), JABALPUR

Reaccredited 'A+ 'Grade by NAAC(CGPA:3.68/4.00)
College with Potential for Excellence by UGC
DST-FIST Supported & STAR College Scheme by DBT

Faculty of Science

Bachelor of Science (B.Sc.)

SUBJECT: NANOTECHNOLOGY

B.Sc. III Semester

Paper-Major

SYNTHESIS TECHNIQUES OF NANO MATERIALS

Course Outcome

CLO No.	Course Outcomes	Cognitive Level*
CLO -I	Students will be able to Identify and understand various top-down and bottom-up approaches for nanomaterial synthesis.	U, R
CLO -II	Students will be able to explain various top down processes.	U, R, Ap
CLO -III	Students will be able to understand different deposition techniques.	R, U, Ap, An, E
CLO -IV	Students will be able to understand Concept of reducing and capping agents in the synthesis processes of nano scale biological systems	U, An, Ap, E, C
CLO -V	Students will understand deposition parameters and their effects on film growth.	U, R, An, Ap, E

Credit and Marking Scheme

	Credits	Marks		Total Marks
		Internal	External	
Theory	4	40	60	**100**
Practical	2	40	60	**100**
Total	**6**	**200**		

Evaluation Scheme

	Marks	
	Internal	**External**
Theory	3 Internal Exams of 20 Marks (During the Semester) (Best 2 will be taken)	1 External Exams (At the End of Semester)
Practical	3 Internal Exams (During the Semester) (Best 2 will be taken)	1 External Exams (At the End of Semester)

Content of the Course

Theory

No. of Lectures (in hours per week): 4.5 Hrs. per week
Total No. of Lectures: 60 Hrs.+ Tutorials (5 Hrs.) **Maximum Marks:** 60

Units	Topics	No. of Lectures
I	**Basics of Synthesis Methods** Introduction: Classification of Fabrication methods; Top-down approach, Bottom-up approach, Top-Down fabrication methods –Types of Top-Down fabrication methods (mechano synthesis, thermal, high energy, chemical fabrication and lithography-concepts with examples only). Bottom-Up fabrication methods-Types of Bottom-Up fabrication methods (gaseous-phase, liquid-phase, solid-phase, template (Specific Examples) synthesis-concepts with examples only). Nano perspective of the fabrication methods.	13
II	**Physical Methods** Mechanical Methods: High Energy Ball Milling, Melt Mixing, Methods Based on Evaporation: Physical Vapor Deposition with Consolidation, Ionized Cluster Beam Deposition ,Laser Vaporization (Ablation) , Sputter Deposition :DC Sputtering , RF Sputtering, Magnetron Sputtering, ECR Plasma Deposition , Chemical Vapor Deposition (CVD) , Ion Beam Techniques (Ion Implantation),Molecular Beam Epitaxy (MBE)	13
III	**Chemical Methods** i) Combustion: Chemical etching of silicon ii) Basic concepts of Chemical-Mechanical polishing iii) Anodization and Electro-polishing: Chemical reactions of electro-deposition of aluminum. Introduction to molecular self-assembly (MSA), Template synthesis, Sol-	13

	gel methods, metal reduction, emulsion polymerization, block copolymerization, electro-deposition with examples and reactions involved.	
IV	**Biological Methods** Biological synthesis of Nanoparticles, Concept of reducing and capping agents, introduction to biomolecules as reducing and capping agents, Bacteria, fungi and plants as sources of reducing and capping agents and for biogenic synthesis of nano-materials. Advantages and applications of biologically synthesized nano-materials. Introduction to biological nano-materials. Bio-mineralization, Magnetosomes, DNA based Nano structures, Protein based Nano structures	**13**
V	**Thin film Deposition** Definition of thin films- Environment (Gas phase and plasma) for thin film deposition, Deposition parameters and their effects on film growth; Physical parameters for evaluation of thin films- Surface roughness; Density; Stress in thin films; Adhesion; Stoichiometry.	**13**

References

Test/Reference Books:

1. Introduction to nanoscience and nanotechnology, CRC Press, Tylor and Francis Group, Boca Raton, G. L. Hornyak, H. F. Tibbals, J. Dutta and J J. Moore.
2. Introductory Nanoscience: Physical and Chemical Concepts, CRC Press, Tylor and Francis Group, Boca Raton, M. Kuno.
3. Nanotechnology : Principles and Practices - S. K. Kulkarni (3rd Edition)

Web Links:

1) NPTEL: Nanotechnology, Science and Applications

https://nptel.ac.in/courses/113/106/113106093/

2) YOUTUBE: Introduction to Nanomaterials

https://www.youtube.com/watch?v=qUEbxTkPIWI

List of Experiments

1. To Synthesize the Thin Films using Sol-Gel Spin Coating system
2. To Synthesize the Thin Films using Chemical Route Synthesis method
3. To Deposit the Thin Films of Conductors using CVD System
4. Synthesis of metal nanoparticles by wet chemical route.
5. Synthesis of ZnO nanoparticles Sol-Gel Method.
6. Growth of quantum dots by thermal evaporation.
7. Synthesis of Ag nanoparticles using sodium borohydride (Creighton's method).

8. Synthesis of Au nanoparticles using citric acid (Lee –Meisel method)
9. Synthesis of Iron Oxide Nanoparticle
10. Synthesis of Nickel Ferrite nanoparticle by urea/citric acid decomposition method
11. Synthesis of Gold Nanoparticles by biogenic methods
12. Synthesis of Silver Nanoparticles by biogenic methods