

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. SEMESTER : VIII

METALLURGICAL ENGINEERING

Subject Name: **NANO- MATERIALS AND TECHNOLOGY**

Sr. No.	Course Contents	Total Hrs
1.	Introduction to nanomaterials and nanotechnology, historical developments. An overview of scope & applications of nanotechnology. Classifications and types of nanomaterials.	2
2.	Basic understanding of various phenomena at nano scale namely size confinement, interfacial surface phenomena.	4
3.	Introduction to basic building blocks namely atoms, molecules, self-assembly, carbon nanotubes, nanocrystals, nanoclusters, nanocapsules, fullerenes, quantum dots, and quantum wires and nanoporous materials.	8
4.	Functional properties of nanomaterials such as physical, mechanical, electrical, magnetic, chemical and optical properties. Size dependence of material at nano scale. Bulk vs nano properties of materials.	8
5.	Synthesis & fabrication techniques: 'Top down' vs 'Bottom-up' approach of synthesis. Review of synthesis methods namely sol-gel method, chemical vapour deposition, physical vapour deposition, sputtering, plasma deposition process, micro emulsion technique, inert gas condensation, mechanical milling, devitrification of amorphous phases, etc. Basics of nanofabrication techniques such as epitaxial growth, nanolithography & self-assembly	12
6.	Consolidation methods for nanopowders such as cold isostatic pressing (CIP), hot isostatic pressing (HIP), Dynamic compaction, Conventional and Microwave sintering. Diffusion and growth kinetics of nanostructured materials during sintering. Effect of grain size on mechanical properties of nano structured materials.	10
7.	Characterization of nanomaterials. An introduction to characterization techniques like transmission electron microscopy (TEM), scanning tunneling microscopy (STM), scanning probe microscopy (SPM), atomic force microscopy (AFM) etc.	10
8.	Applications of nanomaterials namely nanograined structural materials & nanocomposites, nanomagnetic materials, chemical applications etc.	6

TEXT/REFERENCES:

1. Nano Materials by A.K.Bandopadhyay New Age International Publishers
2. Introduction to Nanoscience and Nanotechnology by K.K.Chattopadhyay and A.N.Banerjee, PHI Learning Pvt. Ltd.
3. Nanostructured Materials: Processing, Properties and Applications, ed. by C.C. Koch, William Andrew Publishing, New York, 2002.
4. Nanotechnology by George Timp, Springer-Verlag, New York, 1999.
5. Nanoparticles and Nanostructured Films: Preparation, characterization & Applications, ed. by J.H. Fendler, John Wiley & Sons, 1998.
6. Handbook of Nanophase and Nanostructured Materials, ed. by Z.L. Wang, Z. Zhang and Y. Lim, Kluwer Academic Publisher, 2002.
7. Handbook of Nanostructured Materials and Nanotechnology, ed. by H.S. Nalwa, Vol. 1-5, Academic Press, 2002.
8. Carbon Nanotubes: Science and Applications ed. by M. Meyyappan, CRC Press, Boca Raton Florida, 2004.
9. Processing and Properties of Structural Nanomaterials, Leon L. Shaw, C. Suryanarayana & Rajiv S. Mishra, TMS, 2003.
10. Nanomaterials: Synthesis, Properties & Applications, ed. by A.S. Edelstein and R.C. Cammarata, published by Institute of Physics, UK, 1996.