I YEAR M. TECH (MACHINE DESIGN) SECOND SEMESTER

17MEMD2T5D **NANO TECHNOLOGY** **Credits 4**

Lecture: 4 periods/week **Internal assessment: 40 marks**

Tutorial: - - **Semester end examination: 60 marks**

COURSE OBJECTIVES:

To enable the students to

- Study the material property changes that changes with size, scale and dimensions
- Demonstrate different nano particle fabrication methods
- Recognize different imaging, scanning and probing techniques.
- Illustrate different synthesis methods of metal and semiconductor Nano particles
- Acquire knowledge and applications of carbon nano tubes

COURSE OUTCOMES:

Upon completion of course student be able to

1. Recognize importance of nano materials
2. Characterize nano materials by SEM, STM, AFM etc
3. Describe different nano particle fabrication methods
4. Identify different synthesis methods for semi conductor and metal nano particles
5. List the applications of carbon nano tubes

UNIT-I

INTRODUCTION:

Size and shape dependence of material properties at the nanoscale, Nanoscale elements in conventional technologies.

NANO FABRICATION:

Top-down and bottom-up nanofabrication lithography, etching, ion implantation, thin film deposition, Electron beam lithography, Soft lithography: nano imprinting and micro contact printing, Solution/plasma-phase nanofabrication, sol-gel methods, template techniques.

UNIT-II

SELF ASSEMBLY AND SELF-ORGANIZATION:

Functional coatings with self assembled monolayers of molecules and nanoparticles Langmuir-Blodgett films, layer-by-layer growth.

IMAGING/CHARACTERIZATION OF NANOSTRUCTURES:

General considerations for imaging, Scanning probe techniques: SEM, STM, AFM, NSOM.

UNIT-III

METAL AND SEMICONDUCTOR NANOPARTICLES:

Synthesis, stability, control of size, Optical and electronic properties, Ultra-sensitive imaging and detection with nano particles, bioengineering applications, Catalysis.

SEMICONDUCTOR AND METAL NANOWIRES:

Vapor/liquid/solid growth and other synthesis techniques, Nano wire transistors and sensors.

UNIT-IV

CARBON NANOTUBES:

Structure and synthesis, Electronic, vibrational, and mechanical properties, enabling faster computers using carbon nano tubes, brighter TV screens and stronger mechanical reinforcement,

Mechanics at nanoscale Enhancement of mechanical properties with decreasing size, Nano electromechanical systems, Nano machines, Nano fluidics, filtration, sorting, Molecular motors.

Learning Resources

Text Books:

1. Nanoscale Science and Technology by Kelsall, Hamley, and Geoghegan, Wiley (2005)
2. Introduction to Nanoscale Science and Technology by Di Ventra, Evoy, and Heflin, Kluwer Academic Publishers (2004).

References:

1. Introduction to Nanotechnology by Poole and Owens, Wiley (2003).
2. Nanochemistry: A Chemical Approach to Nanomaterials by Ozin and Arsenault, RSC Publishing