

# Nanostructures and Nanomaterials: Characterization and Properties - Video course

## COURSE OUTLINE

Nanostructures and Nanomaterials:

Characterization and Properties will provide an overview of nanostructures evincing their fascinating properties (mechanical, optical, electromagnetic, chemical, and biological) unseen otherwise.

The hierarchical development from nano to macro length scale, and its adoption in nature (biomimicking) will also be discussed.

Understanding the change in crystal structure and defects therein as one goes from bulk to nano length scale will be utilized to construct structure-mechanism-property-performance maps.

Thermodynamics resulting from the size effects at nano-length scales will also be considered.

Structural, phase, microstructural and mechanical characterization techniques will be dealt in detail.

## COURSE DETAIL

S.No	Topics	No.of.Hours
1	Overview of Nanostructures and Nanomaterials: classification	3
2	Crystalline nanomaterials and defects therein. Hybrid nanomaterials	3
3	Multiscale hierarchical structures built out of nanosized building blocks (nano to macro). Nanomaterials in Nature: Nacre, Gecko, Teeth.	4
4	Nanostructures: Carbon Nanotubes, Fullerenes, Nanowires, Quantum Dots. Applications of nanostructures. Reinforcement in Ceramics, Drug delivery, Giant magnetoresistance, etc. Cells response to Nanostructures.	3
5	Surfaces and interfaces in nanostructures. Ceramic interfaces, Superhydrophobic surfaces, Grain boundaries in Nanocrystalline materials, Defects associated with interfaces.	4



NP-TEL

# NPTEL

<http://nptel.iitm.ac.in>

## Nanotechnology

### Pre-requisites:

Materials Science and Engineering.

### Additional Reading:

Encyclopedia of Nanoscience and Nanotechnology, Ed.: Hari Singh Nalwa, American Scientific Publishers, 2004.

### Coordinators:

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6	Thermodynamics of Nanomaterials.	3
7	Overview of properties of nanostructures and nanomaterials. How the performance of nanomaterials come about: sizestructure-Mechanism-property-performance pathway	4
8	Overview of characterization of nanostructures and nanomaterials.	3
9	Focus on: Brunauer-Emmett-Teller (BET) technique, Transmission Electron Microscopic techniques, Auger Electron Spectroscopy, X-ray Photoelectron Spectroscopy. Electron Energy Loss Spectroscopy.	6
10	Deformation behaviour of nanomaterials. Fracture and creep. Nanomechanics and nanotribology.	4
11	Electrical, Magnetic and Optical properties	5
	<b>Total</b>	42

#### References:

1. Nanomaterials, Nanotechnologies and Design: an Introduction to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann, 2009.
2. Handbook of Nanophase and Nanostructured Materials (in four volumes), Eds: Z.L. Wang, Y. Liu, Z. Zhang, Kluwer Academic/Plenum Publishers, 2003.
3. Handbook of Nanoceramics and their Based Nanodevices (Vol. 2) Edited by Tseung-Yuen Tseng and Hari Singh Nalwa, American Scientific Publishers.