

# Nanoscience

Concepts & Fundamentals

Nanoscience and Nanotechnology are the hottest frontiers in scientific and technological development today. Dealing with the manipulation of atoms at the  $10^{-9}$ m scale to produce wonderful new substances, their applications have already begun changing life as we know it. Scientists have started calling the 21st century the 'Century of Nanotechnology'.

This book is written taking into account the current syllabi of undergraduate and graduate level programs of Nanoscience and Nanotechnology Courses of various Indian Colleges and Universities such as UP Technical University, Uttarakhand Technical University, Rajasthan Technical University, Panjab Technical University, Jawaharlal Nehru Technical University, Delhi Technical University and Chhattisgarh (Swami Vivekanand) Technical University etc.

The book comprises of five chapters.

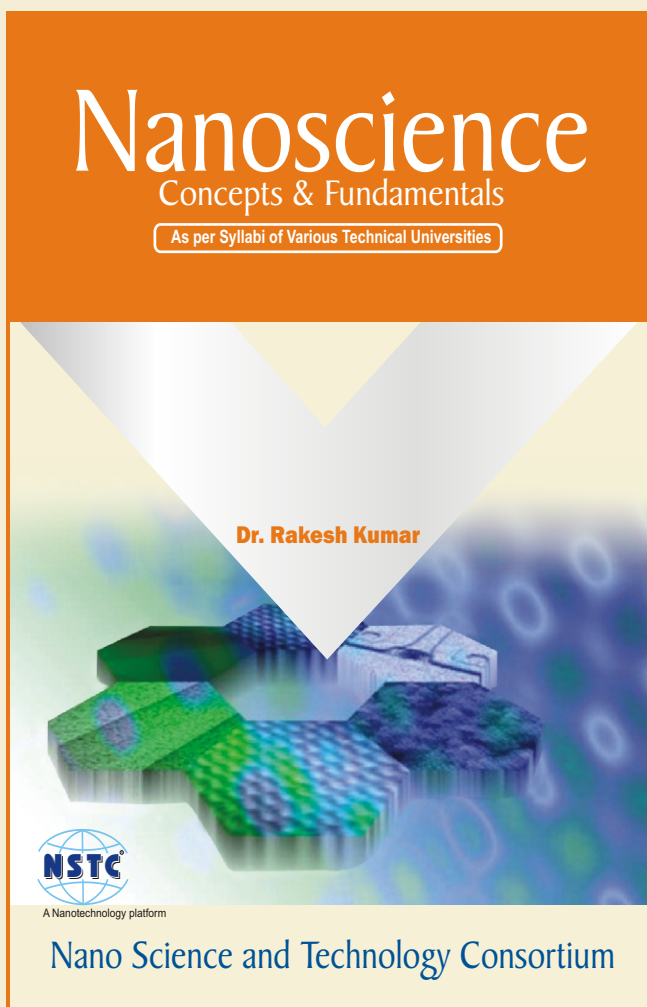
- **Chapter 1** is an introductory account that discusses the multidisciplinary nature of Nanoscience and its potential to influence almost all the areas of Science and Engineering.
- **Chapter 2** presents quantum mechanics and its correlation to nanoparticles in the form of quantum dots, quantum wires and clusters.
- **Chapters 3 & 4** discuss in detail, the techniques that are commonly employed in the preparation and characterization of Nanoparticles.
- **Chapter 5** deals with the most popular and sought - after research materials, namely, the bucky ball, carbon nanotubes, nanodiamonds, nanorobots and nanobiometrics.

The author attempts to make the study of the subject simple, relevant and interesting by presenting both basic concepts and advanced research findings in a lucid, practical manner. This book should act as a model Indian text book for engineering and science students, studying nanoscience as a subject.

**Dr. Rakesh Kumar** is a Master of Science and Master of Technology (Bio-chemical Engineering) from IIT, Roorkee and Institute of Technology, Varanasi, respectively, and a Ph.D from IIT, Delhi, India. He worked as postdoctoral fellow in Department of Chemistry, Wuhan University, China & is presently working as Researcher in MSM, CSIR, Port Elizabeth, South Africa. His area of research is biodegradable plastics and composites.

**Nano Science & Technology Consortium (NSTC)** is a non-governmental, privately managed and promoted body. It aims to provide and facilitate in providing the services, that lead to awareness creation, research and development, consultancy, collaborations, technology transfer and commercialization in the field of Nanotechnology.

NSTC's mission is to create a collective voice for the emerging nanotechnology industry, and develop a range of initiatives to support and strengthen the nanotechnology business community.



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# Introduction to Nanotechnology

Nanoscience and Nanotechnology are the hottest frontiers in scientific and technological development today. Dealing with the manipulation of atoms at the  $10^{-9}$ m scale to produce wonderful new substances, their applications have already begun changing life as we know it. Scientists have started calling the 21st century the 'Century of Nanotechnology'.

This book gives an overview of the basic concepts of nanotechnology and discusses how nanotechnology is affecting our daily lives. It covers the development of nanotechnology down the ages, and then goes on to explain the basics of nanostructures and nano characterization. The book then rounds off the discussion by giving the application of nanotechnology in various sectors such as sports, textiles, medicine and automobiles.

The book comprises of two modules **Fundamentals of Nanotechnology** and **Nanotechnology in various sectors**

Fundamentals of Nanotechnology has five following units

**Unit 1** explains Nanotechnology in pre-18<sup>th</sup>, 19<sup>th</sup>, 20<sup>th</sup> and pre-21<sup>st</sup> centuries.

**Unit 2** demonstrates about the Nano and Nanometer.

**Unit 3** defines nanoscience & nanotechnology in detail. It also explains their components.

**Unit 4** presents the scenario of nanotechnology in modern era.

**Unit 5** ensures the possible applications of nanotechnology in important fields.

Nanotechnology in Various Sectors has ten units. This module explains the possible applications of nanotechnology in following different sectors in detail.

**Unit 1** Nanotechnology in Agriculture/Food

**Unit 2** Nanotechnology in Electronics

**Unit 3** Nanotechnology in Textile

**Unit 4** Nanotechnology in Construction

**Unit 5** Nanotechnology in Energy

**Unit 6** Additional Applications of Nanotechnology in Medicine & Pharmaceuticals

**Unit 7** Nanotechnology in Automobiles

**Unit 8** Nanotechnology in Environment

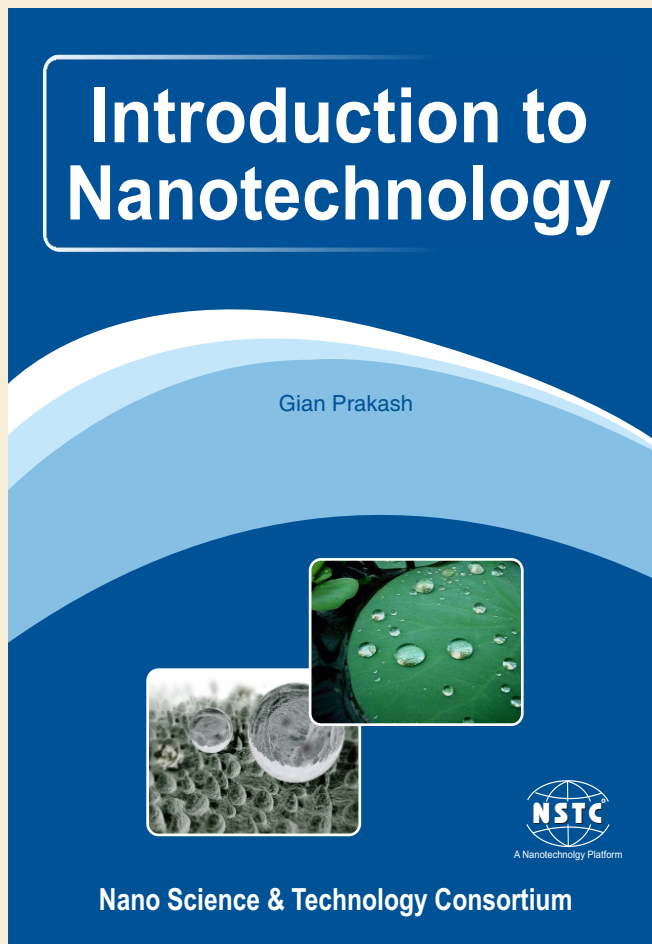
**Unit 9** Nanotechnology in Sports

**Unit 10** Nanotechnology in Chemicals and Paints

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# Nanotechnology

NANO CHEMISTRY  
NANO PHYSICS  
NANO BIOLOGY

Nanoscience and Nanotechnology are the hottest frontiers in scientific and technological development today. Dealing with the manipulation of atoms at the  $10^{-9}$ m scale to produce wonderful new substances, their applications have already begun changing life as we know it. Scientists have started calling the 21st century the 'Century of Nanotechnology'.

This presentation covers the fundamental principles of Nano Chemistry, Nano Physics and Nano Biology in detail. Types of metallic nano particles, Nano composites, Nano robotics, Nano electronics, Nano magnetism, Nano capsules, Nano pharmacology and Nano Biotechnology are some of the topics discussed in the book.

The book is a must for those who want to understand the use of Nanotechnology and its linkage with the scientific principles learnt at the intermediate and graduation level. It is a lucid description of the enhancements of the application areas of the three basic sciences using nanotechnology.

The book comprises of three units as Nano Chemistry, Nano Physics and Nano Biology. They are the fundamental sciences of nanoscience and nanotechnology.

**Units1. Nano Chemistry:** This unit explains the part of the chemistry which works at nanoscaled. The following topics are discussed in detail

- Basics of Nano Chemistry
- Nano Particles
- Carbon Nanotubes
- Nano Composites

**Unit 2. Nano Physics:** It demonstrates the part of physics which works at nanoscale.

- The following topics are discussed in depth
- Basics of Nano Physics
  - Nano Electronics
  - Nano Robotics
  - Nano Magnetism

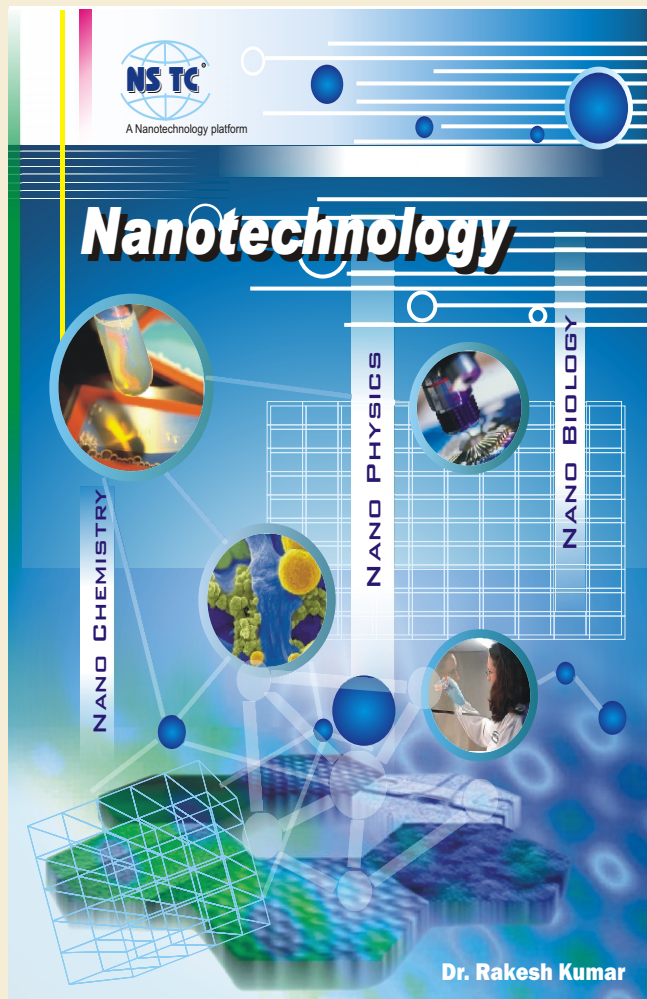
**Unit 3. Nano Biology:** It explains the part of biology which works at the nanoscaled. The following topics are demonstrated in general.

- Basics of Nanobiology
- Nanobiology Today
- Nanomedicine
- Biomedical Applications of Nanobiology

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# Carbon Nanotubes

Technology and Applications

Nanoscience and Nanotechnology are the hottest frontiers in scientific and technological development today. Dealing with the manipulation of atoms at the  $10^{-9}$ m scale to produce wonderful new substances, their applications have already begun changing life as we know it. Scientists have started calling the 21st century the 'Century of Nanotechnology'.

Carbon nanotubes (CNTs) are extraordinary molecules due to the simplicity of their structure. Bulk, as well as part by part modification, such as tips, outer or inner walls of CNTs is possible. This helps scientists to achieve the desired properties of the end products.

This text is written especially for those who have had no instruction or limited instruction in CNTs. In this book, we give an idea of technology relating to CNTs as well as R&D taking place all over the world. Several projects that have been sanctioned in India, a comprehensive list of companies and more than 100 patents relating to CNTs have been given.

The book comprises of five chapters.

**Chapter 1** is an introductory account that discusses the basics constituent materials responsible for invention of carbon Nanotubes.

**Chapter 2** presents technology behind the carbon Nanotubes and their various industrial applications. It explains in details the types of carbon Nanotubes, various properties of carbon nanotubes and industrial applications. This chapter presents the synthesis/production and characterization of carbon Nanotubes. In general it discusses CNT technology development in India and World.

**Chapter 3** presents numbers of patents granted in the different area of CNTs in the last 10 years and also explains about the scientific literatures. It also provides the list of patents.

**Chapter 4** deals with the support for CNT research and challenges by worldwide Governments and also Indian Government. It also discusses the environmental, health and safety issues relating to CNTs.

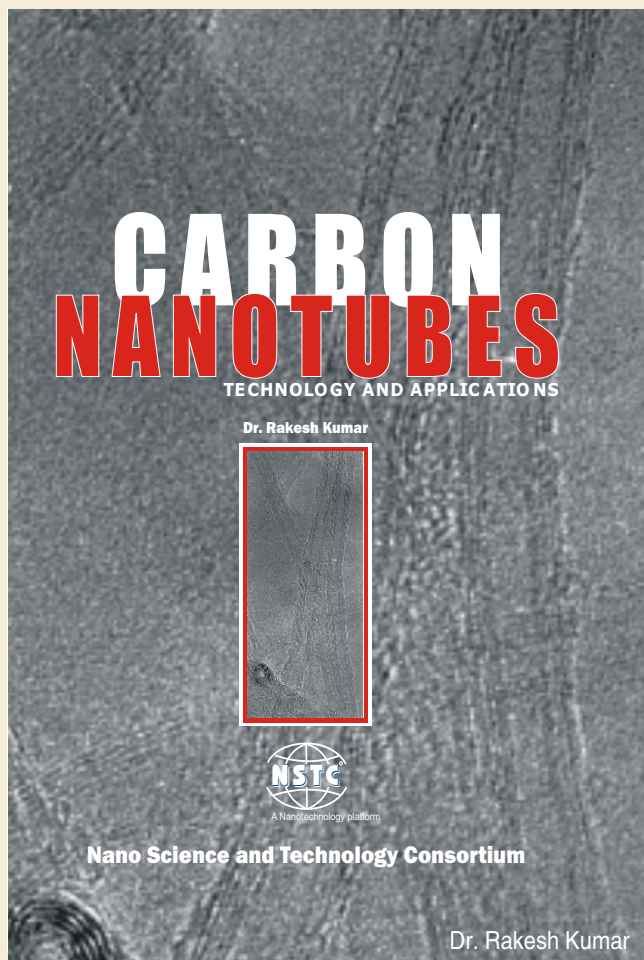
**Chapter 5** provides the valuable information about the industries involved in the production of CNTs worldwide.

The author attempts to make the study of the subject simple, relevant and interesting by presenting both basic concepts and advanced research findings in a lucid, practical manner.

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# Nano Structures

Concepts & Fundamentals

Nanoscience and Nanotechnology are the hottest frontiers in scientific and technological development today. Dealing with the manipulation of atoms at the  $10^{-9}$ m scale to produce wonderful new substances, their applications have already begun changing life as we know it. Scientists have started calling the 21st century the 'Century of Nanotechnology'.

This book presents an introduction to Nanostructures. Synthesis of different types of Nanostructures and their applications have also been presented and discussed. Nanostructures have structural applications and optical/electronic properties for application in advanced devices. The book provides a presentation of the experimental and theoretical aspects concerning the preparation and characterization of Nanostructures.

The book comprises of twelve chapters.

This book explains about the following nanostructures, their properties and various preparations methods in detail. It also explains the important applications.

## Chapters

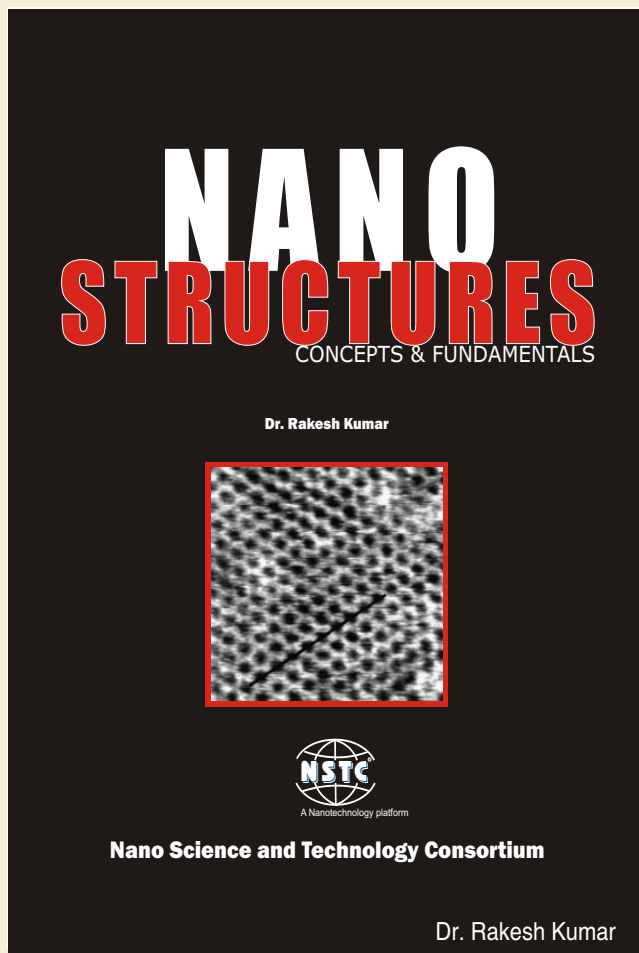
1. Sculptured Thin Films
2. Quantum Heterostructures
3. Nanocomposites
4. Nanofabrics
5. Nanocapsules
6. Dendrimers
7. Nanoshells
8. Nanocages
9. Nanoflowers
10. Nanofoams
11. Nanofibers
12. Nanomesh
13. Nanotubes
14. Fullerenes

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# Nano Materials

*Concepts & Fundamentals*

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This book presents an introduction to Nanomaterials. Dimensional classification of Nanomaterials and their various properties have also been presented and discussed. Nanomaterials have various applications in molecular electronics, photonic crystals, hydrogen storage, and in biology that have demonstrated in this book and also health hazards of Nanomaterials with their proper solutions have discussed in detail.

The book consists of following chapters.

**Chapter 1:** explains the basics concepts of Nanomaterials historically and technically. This chapter explains the magical effects of Nanomaterials in nature and teaches to scientist how they can apply these effects in their products. It also connects reader to the brilliant applications of Nanomaterials.

**Chapter 2** provides the different kinds of dimensional classifications of Nanomaterials and their nature of origin.

**Chapter 3** describes physics behind Nanomaterials and their various properties in detail.

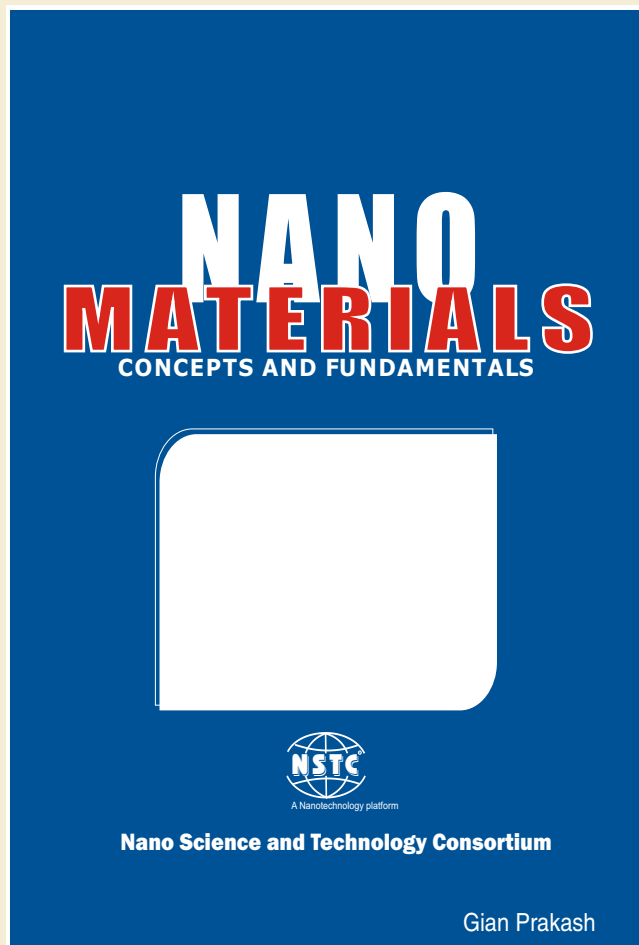
**Chapter 4** explains the diverge range of applications of Nanomaterials in molecular electronics, optics, communications, biotechnology, cosmetics, and paints , storage materials for new generation of fuels , food additives, novel materials, catalysts and many others in detail.

**Chapter 5** aware the reader about the health hazard effects of Nanomaterials and provides the better solutions for minimizing theses effects.

The author attempts to make the study of the subject simple, relevant and interesting by presenting both basic concepts and advanced research findings in a lucid, practical manner.

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# Nano - Characterization and Manipulation

## Concepts & Fundamentals

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The book covers various characterization tools such as TEMs, SEMs, XRD, AFMs and STMs. It then goes on to discuss Molecular Nanomechanics, Nanomanipulation, Nanolithography and Nanocomputation.

This presentation is a comprehensive coverage of all the topics needed to get a holistic view of the field of Nanocharacterization and Manipulation at the advanced level.

This book comprises of four chapters

**Chapter 1** focuses on Nanomaterials characterization. In this chapter various characterization techniques are explained with relevant examples such as Transmission Electron Microscope, Scanning Electron Microscope, X-Ray Diffraction, Online Monitoring of Nanoparticles, Atomic Force Microscopy, Zeta-Potential, Thermogravimetric Analysis, Differential Scanning Calorimetry, Dynamic Mechanical Analysis, and Scanning Tunneling Microscope. It also explains the various Nano Tensiles Tests and structural characterization of nanomaterials.

**Chapter 2** focuses on Molecular Nanomechanics which explains the topics such as molecular dynamics, nanomechanics of CNT, Bridging Scale Method, Nanomechanical Biosensors, Nanomechanics of Adhesion Proteins, Nanotribology and Nanomechanics, Nanomechanics in Natural Fibers.

**Chapter 3** focuses on the Nanomanipulation and Nanolithography. It explains the various nanometer size template fabrication methods with relevant examples. It also discusses the Nano-Electromechanical Systems and catalytic technology. Need of manipulation at nanoscale is discussed in this chapter.

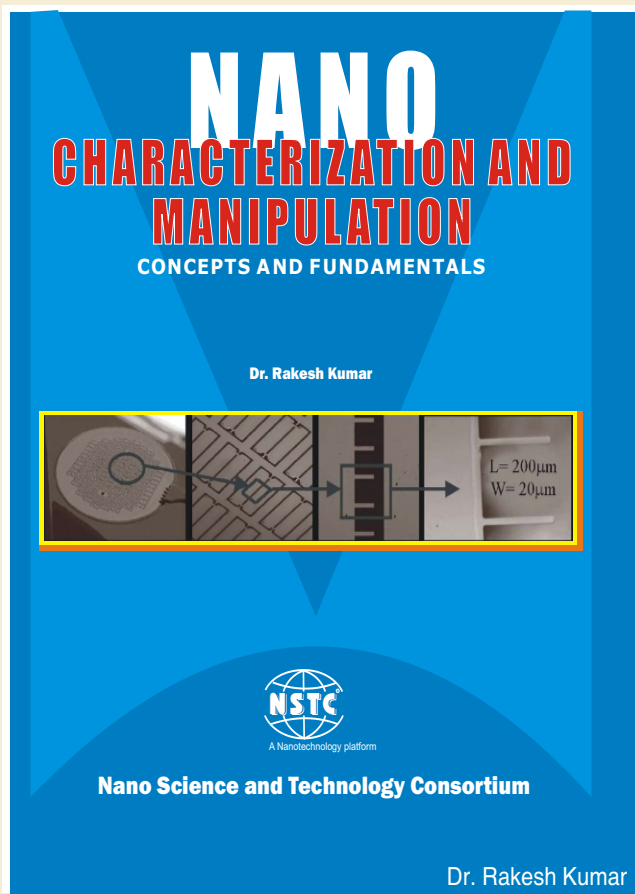
**Chapter 4** Focuses on Nano Computation. It explains the faceted melt/crystal interfaces and Nanomaterials design for high TC Ferromagnetism. It demonstrates the computer simulation for the interaction of Nanomaterials and multiscale nanocomputation for solidification phenomena.

The author attempts to make the study of the subject simple, relevant and interesting by presenting both basic concepts and advanced research findings in a lucid, practical manner.

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# Nano Synthesis and Fabrication

Concepts & Fundamentals

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Synthesis of nanostructures is a fascinating field. This publication deals in depth with Epitaxial Growth, Self-Assembly, Top-Down and Bottom-Up Approaches and Hybrid Techniques and Materials.

The detailed coverage of each topic ensures a thorough grounding in their fundamental concepts and application areas. The book covers each concept thoroughly, and also depicts concepts visually using images from various stages of synthesis and fabrication.

This book comprises of four chapters.

**Chapter 1** explains the basics of epitaxial growth and demonstrates the epitaxial growth by Molecular Beam Epitaxy methods in detail. This explains the analyzing techniques of growth and various examples of epitaxial film with growth mechanism in detail. This chapter also explains in depth the electronics properties of epitaxial materials and also provides the future directions.

**Chapter 2** introduces to self assembly and explains its principles. It also explains the self assembly of different nano metals and compounds in detail. This chapter focuses on efficiency self assembled Nanomaterials and demonstrates their several applications.

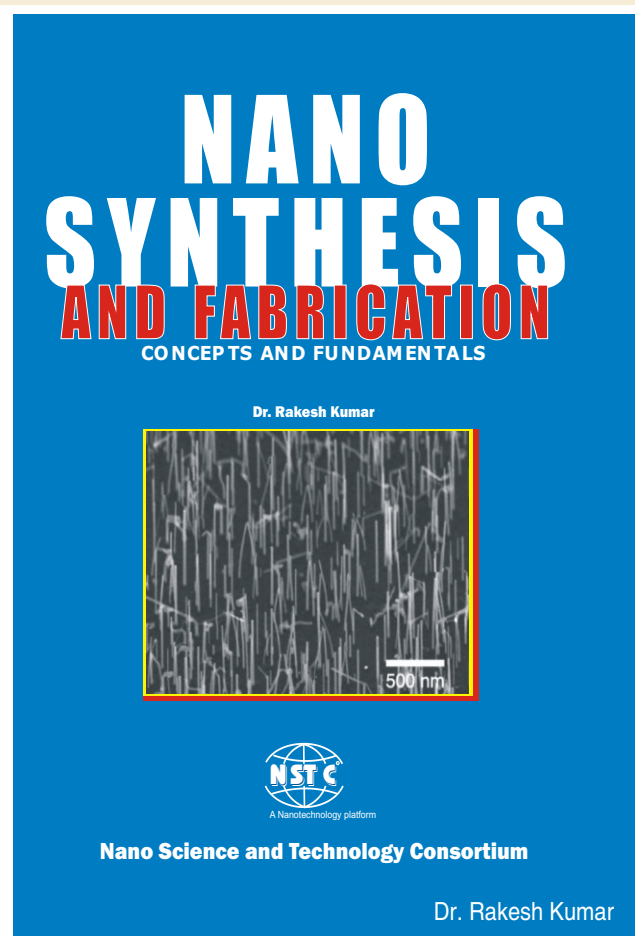
**Chapter 3** explains the top down and bottom up approaches in general and also demonstrates in depth High Energy Ball Milling as Top Down Approach. In Bottom Up Approach category several techniques are discussed. Under this category several system which utilize bottom up approach for the preparation of nano based materials are discussed in details.

**Chapter 4** explains about hybrid Nanomaterials and also hybrid techniques for the formation of Nanomaterials in detail. It explains various applications of hybrid Nanomaterials.

The author attempts to make the study of the subject simple, relevant and interesting by presenting both basic concepts and advanced research findings in a lucid, practical manner.

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# Bio Nano

Concepts & Fundamentals

Medical research is now focusing increasingly on the micro and nano scale. Concepts such as lab-on-a-chip (microarrays) are now being used the world over to facilitate ultra-sophisticated tests while taking a negligible amount of biological material from the patient. Nanostructures such as quantum dots and dendrimers have started finding extensive applications in curing cancer, and the silver nanoparticle is considered a prime candidate for fighting viruses such as AIDS.

Each of these advances has needed manipulation at the nanoscale. An increasing amount of attention is being paid to development and manipulation of biomaterial at the nano-level, because that is the way nature works. Nature uses miniscule building blocks such as DNA to build huge structures such as the human body. Hence, medical research is now tending toward the view that to correct seemingly incurable defects, a thorough understanding of Bionanostructures such as DNA is imperative. The study and manipulation of structures at the nanoscale and their use in medical applications is known as Bionanotechnology.

The book comprises of four chapters.

**Chapter 1** presents overview of bionanotechnology. It describes origin of bionanotechnology and the importance of nanosize in drug delivery. This chapter explains opportunities, challenges of bionanotechnology and an insight into nanotoxicology.

**Chapter 2** describes the physics of bionanotechnology in details. Physics is the science which gave birth to nanoscience and nanotechnology, therefore this becomes important to understand the basic phenomenon of physics. This chapter explains laws of classical thermodynamics and inter & intra molecular forces which generate nanoscaled effects. It also describes the physics of solid state and basics concepts of quantum theories. Biological conversion of energy is also explained.

**Chapter 3** presents the self assembled nanostructures and explain in detail the self assembly enables nanotechnology. It describes the self assembled DNA nanostructures, nanowire biosensors, self assembled Nanotubes and more.

**Chapter 4** describes the nature inspired bionanotechnology. It explains the magical effects at nanoscaled generated by the nature. It also explains protein folding, molecular biology, and animal health nanotechnology.

The author attempts to make the study of the subject simple, relevant and interesting by presenting both basic concepts and advanced research findings in a lucid, practical manner.

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# Bionanomaterials

Concepts & Fundamentals

An increasing amount of attention is being paid to development and manipulation of biomaterial at the nano-level, because that is the way nature works. Nature uses miniscule building blocks such as DNA to build huge structures such as the human body. Hence, medical research is now tending toward the view that to correct seemingly incurable defects, a thorough understanding of Bionanostructures such as DNA is imperative. The study and manipulation of structures at the nanoscale and their use in medical applications is known as Bionanotechnology

Currently there is increasing interest in exploitation of principles underlying formation of natural biomolecules: polypeptides, proteins and nucleic acids for the design and synthesis of polymeric molecules of predetermined structure and properties, called nanostructures and their use in construction of novel nanodevices for a variety of applications in medicine and technology. The fast growing research in this area merges into a new discipline named bionanotechnology.

This book describes bionanomaterial in detail. It provides the classifications of bionanomaterial and discusses the characterization and properties of nanostructures biomaterials. It explains thoroughly the applications of bionanomaterials and functional bionanomaterial. Finally nanocomposites biomaterials are discussed in detail.

The book comprises of five chapters

**Chapter 1** explains the classifications of bionanomaterials and benefits in detail.

**Chapter 2** describes the characterization & properties of nanostructured materials. It explains the structural characterization and chemical characterization in details. It also describes the characterization of nanobiosensors.

**Chapter 3** explains the biomedical applications of various bionanomaterials and nanostructures in detail. It describes the about applications of nanobiodevices, nanopore technology and nano self assembling systems.

**Chapter 4** presents the functional bionanomaterial. It explains Aptamer based nanobiosensors, nanorobots and functional DNA based sensors. This chapter also states about the nanochopper.

**Chapter 5** presents the nanocomposite biomaterials in details. It explains properties of nanocomposites biomaterial and their types. It also explains thoroughly bionanocomposites and nanoclusters.

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## Bionanomaterials

Concepts & Fundamentals



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# Bio - Nanomedical

*Technology & Application*

In the last several decades, nanotechnology has been developed in several areas, which include drug delivery, bioMEMS, tissue engineering, biosensors, microfluidics, microarrays, and bioimaging. The nanotechnology-based drug delivery system has emerged to be the mainstream research among all the applications because it offers an extraordinary opportunity to make significant advances in medical diagnosis and treatment. Corporate investment on nanotechnology for drug delivery and medical diagnostics is increasing year by year and nanotechnology-based drug delivery has already been commercialized by a lot of companies. Nanotechnology-based drug delivery is generating continuing interest among researchers at the federal government agencies as well as private industrial sectors.

In medical field drug delivery is very challenging and difficult task therefore nano drug delivery systems make it easy and fruitful. This book explains nano drug delivery systems in detail with their advantages over traditional systems. Quantum dots have been revolutionizing the medical imaging methods so this book describes about quantum dots for biomarkers in detail. It also discusses micro fluidics and micro fluidics devices. Sensors and chips are the fundamentals devices of medical technology thus latest nanobiosensors and biochips are explained here. Enhanced diagnosis and treatment procedures & methods are discussed in details. Nanotech based tissue engineering and regenerative medicine describe thoroughly. Electronics has brilliant role in medical technology thus nanobioelectronics has discussed in this book.

This book consists of seven chapters.

**Chapter 1** explains the various nano drug delivery systems in detail. It also describes nano drug delivery systems advantages and drug release mechanism thoroughly.

**Chapter 2** describes role of quantum dots in medical imaging for biomarkers. It explains developments & characterization of quantum dots and their role as quantitation tags. Biological applications of quantum dots are discussed in detail.

**Chapter 3** presents microfluidics concepts in detail. It describes about active and smart passive micro fluidics devices thoroughly.

**Chapter 4** covers the basic concepts of nanobiosensors and biochips. It describes fiber optics nanosensors systems, LSPR detection, SWNTOxidoreductase Enzyme Nanobiosensors, Anti bodies and Glucose biosensors in detail.

**Chapter 5** presents role of bionanotechnology in diagnosis and treatment. It explains various nanotech based cancer diagnosis & treatment methods.

**Chapter 6** explains impact of nanotechnology on tissue engineering and regenerative medicine. It describes about nanofibrous scaffolds and nanofeatures of ECM.

**Chapter 7** provides perfect insight into nanobioelectronics. It describes nano based neurobioelectronics and molecular electronics in detail.

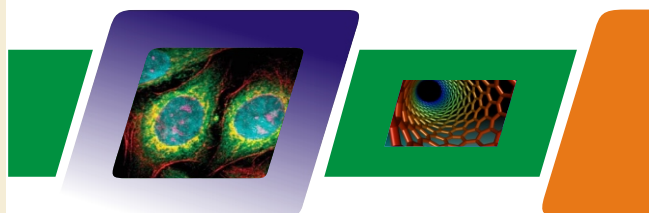
The author attempts to make the study of the subject simple, relevant and interesting by presenting both basic concepts and advanced research findings in a lucid, practical manner.

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## Bio-Nanomedical

Technology & Applications



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## Methods & Tools for Measuring Bio-Nano Properties

Medical research is now focusing increasingly on the micro and nano scale. Concepts such as lab-on-a-chip (microarrays) are now being used the world over to facilitate ultra-sophisticated tests while taking a negligible amount of biological material from the patient. Nanostructures such as quantum dots and dendrimers have started finding extensive applications in curing cancer, and the silver nanoparticle is considered a prime candidate for fighting viruses such as AIDS. These applications are result of amazing properties of the nanostructures which are analyzed and determined by various tools and methods.

In medical science properties of materials play significant and important role in the development of various medical procedures and systems. Medical science can be revolutionized only by enhancing properties at the nanoscaled, therefore Bio-Nano properties come in to play. These properties can be addressed and analyzed by various structural resources, electron microscopy resources and spectroscopy resources. These resources are explained thoroughly in this book.

This book explains various X-ray techniques for structural determination in detail. Electron microscopy has excellent ability for measuring the properties at molecular level, thus this book describes important microscopy basics concepts and methods thoroughly. Various spectroscopy methods have been discussed thoroughly in this book.

**Chapter 1** describes about the structure resources in detail. Structural determination can be done by various X-Ray techniques which have been discussed in this chapter.

**Chapter 2** describes about the important microscopy resources. Need of electron microscopy has been explained here. Various techniques such as Transmission Electron Microscopy, Low Voltage Electron Microscope, ESEM, Atomic Force Microscope, and Scanning Tunneling Microscope are explained thoroughly. How these resources measure bio-nano properties have explained in this chapter.

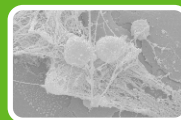
**Chapter 3** describes about various spectroscopy resources. It explains clearly the basic scientific concepts behind spectroscopy. Common types of spectroscopy such FTIR, Ultraviolet Visible Spectrophotometer, Infrared Spectroscopy, Raman Spectroscopy,, NMR Spectroscopy and more are explained with their ability to measure bio-nano properties.

The author attempts to make the study of the subject simple, relevant and interesting by presenting both basic concepts and advanced research findings in a lucid, practical manner.

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### Methods & Tools for Measuring Bio-Nano Properties



Varsha Singh

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# Nanotechnology

Laboratory Principles & Procedures

Nanotechnology is a design, fabrication and application of nanostructures or nanomaterials, and the fundamental understanding of relationships between physical properties or phenomena and material dimensions. It also deals with the materials or structures in nanometer scales, typically ranging from sub nanometers to several hundred nanometers. One nanometer is  $10^{-3}$  micrometer or  $10^{-9}$  meter. Nanotechnology is new field or a new scientific domain. Similar to quantum mechanics, on a nanometer scale materials or structures may possess new physical properties or exhibit new physical phenomena. In order to explore novel physical properties and phenomena and realize potential applications of nanostructures and nanomaterials, the ability to fabricate and process nanomaterials and nanostructures is the first corner stone in nanotechnology.

In nanotechnology laboratory two approaches To down and bottom up have been used to fabricate nanostructures. The top-down approach often uses the traditional workshop or micro fabrication methods where externally-controlled tools are used to cut, mill, and shape materials into the desired shape and order. Micro patterning techniques, such as photolithography and inkjet printing belong to this category. In Bottom up molecule components to (a) self-organize or self-assemble into some useful conformation, or (b) rely on positional assembly. These approaches utilize the concepts of molecular self-assembly and/or molecular recognition.

Nanostructures are defined as structures having at least one dimension between 1 and 100nm. This books covers synthesis and fabrication of nanostructures based on dimensions. Various laboratory procedures for synthesis of zero dimensional Nanostructures such as nanoparticles are described here in detail. One dimensional nanostructures such nanowires, nanorods, nanobelts, nanotubes and nanoribbons are synthesized by spontaneous growth and template based synthesis methods. Two dimensional nanostructures such as thin films are developed by various film growth techniques. Vacuum technology based methods and liquid based growth methods are explained thoroughly here. Important nanostructures such as fullerene, mesoporous material, zeolites and core shell structures synthesis methods have been discussed in this book. With the procedures, applications are also explained.

This book comprises of three chapters

**Chapter 1** describes about the various laboratory procedures for synthesis of zero dimensional nanostructures such as nanoparticles. Quantum dot is one of the important zero dimensional nanostructures, thus synthesis of quantum dot has been discussed. With the properties of zero dimensional nanostructure, applications of nanoparticles have been explained in detail.

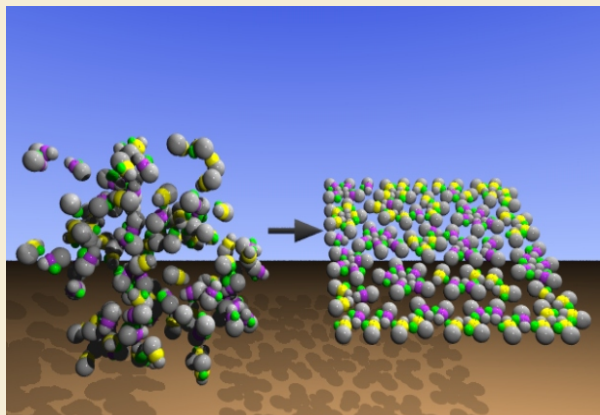
**Chapter 2** introduces about one dimensional nanostructures. Laboratory procedures to synthesize 1-D nanostructures such as spontaneous growth, template based synthesis and electro spinning procedures are discussed thoroughly with examples in this chapter. Applications of 1-D nanostructures are also explained in this chapter.

**Chapter 3** presents various synthesis procedures of 2-D nanostructures. It explains the fundamentals of film growth and vacuum science. Various vapor phase depositions growth procedures and various liquid based growth procedures have been explained in this chapter. Important nanostructures such as fullerenes, carbon Nanotubes, mesoporous materials, zeolites and core shell structures are discussed with their synthesis methods and applications.

The author attempts to make the study of the subject simple, relevant and interesting by presenting both basic concepts and advanced research findings in a lucid, practical manner.

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## Nanotechnology

Laboratory Principles & Procedures

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# Scientific & Technical Writing

Current Concepts & Fundamentals

Technical Writing is every where around us, so much so that it doesn't even get noticed. You get exposed to technical writing in everyday life when you try to operate your new washing machine, camera, or a DVD player using the user's manual.

Technical Writing is a structured way of writing that presents technical information to readers (the audience) in such a way that it is adapted to their needs and understanding level. You write about a technical subject in such a manner that even a new kid on the block could understand. Technical Writing communicates technical information in the form of online help screens, website, user manuals, technical descriptions, training materials, newsletters, reports, information guides etc. As more and more companies are shifting focus to customer- centric approach, an organization's technical writing activities serve as a reflection of its professional attitude.

This book comprises of eight chapters

**Chapter 1** presents an overview of scientific and technical writing. It defines and explains principles of technical writing in detail. Technical writer, who are they and what do they do have been discussed. Detailed information on application areas, jobs, positions, organizations, and training centers in technical writing area is given in this chapter.

**Chapter 2** describes the main categories of scientific and technical documents as primary documents, secondary documents and tertiary documents in detail.

**Chapter 3** explains the basics principles/norms of scientific technical writing (English) in detail. It introduces to the basics rules, elements of style, grammar and good writing. It also describes the US and UK English thoroughly.

**Chapter 4** presents technical writing process and guidelines in detail. It describes task analysis, revision techniques, finding information libraries, documentation and cross referencing in detail.

**Chapter 5** explains important tools in scientific technical communication as Robot Help, Adobe Frame Maker, Microsoft Visio, Microsoft Office Word 2007, Quadralay Web Works and more in detail.

**Chapter 6** describes thoroughly about abstracts, introduction, conclusion and indexes.

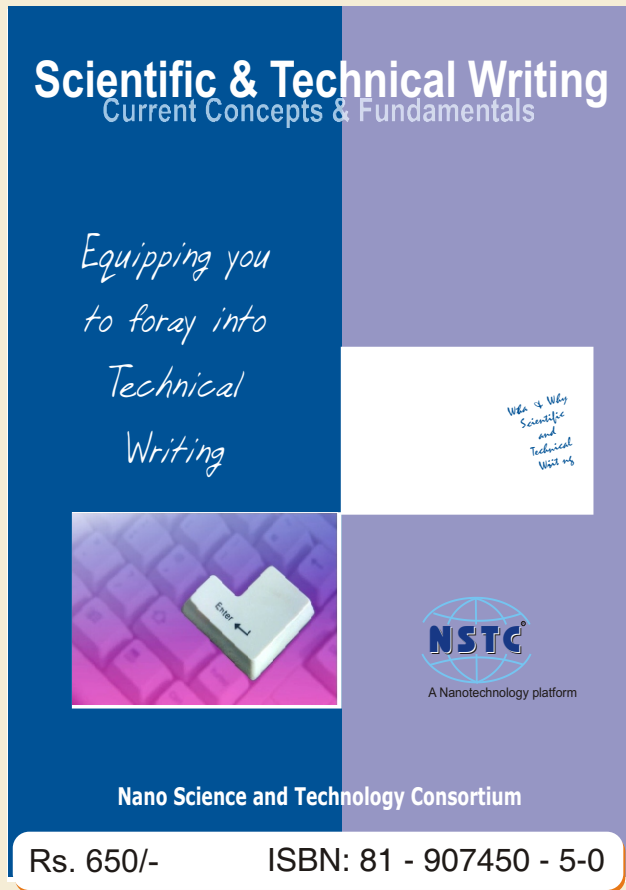
**Chapter 7** presents an overview of oral expression and presentation.

**Chapter 8** explains thoroughly the remedial measures as use and misuse in English writing.

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# Nanotechnology

Potential & Products

Nanotechnology is the study of manipulating matter on an atomic and molecular scale. Generally, nanotechnology deals with developing materials, devices, or other structures possessing at least one dimension sized from 1 to 100 nanometers. Nanotechnology also refers to the study of processes on the nanoscale in the laboratory which facilitates the manufacture of products.

Nanotechnology has tremendous potential in every field of science, engineering and technology. Existing products have been getting marvelous improvements with the applications of nanotechnology.

This book covers importance of nanoscale in research & development by presenting various examples. Various products manufactured by various companies using nanotechnology worldwide have been presented in this book.

This collection gives information on the role of research in developing nano products. After tracing the life-cycle of product development, it then discusses the role of the government in furthering Nanotechnology within the country. The developments around the world and especially in India are discussed in detail, with the chronology of major conferences over the recent past being traced.

This book comprises of three major areas as Research & Development in Nanotechnology, Indian Nanotechnology Perspective and Global Nanotechnology Perspective.

**Research & Development in Nanotechnology** explains about the potential of nanotechnology in scientific domain. It also explains How in laboratory, research at nanoscale leads to the better development of products. Different products produced by various companies worldwide using nanotech has been discussed with their applications in detail.

**Indian Nanotechnology Perspective** describes about the role of government and various industries in promoting nanotechnology in India. It provides an overview of miscellaneous activities such as formation of Nano Parks, Export of Nano based products to India, Joint Ventures and Collaborations and more. It also provides the description of major nanotechnology conferences held in India. Information on Major Universities /institutes which have been providing bachelors, masters' degree programs and research activities in Nanotechnology are being discussed here. It also provides information on various research centers and companies have been working at nanoscale.

**Global Nanotechnology Perspective** describes about the scenario of nanotechnology all over the world. It provides the information on government and industries support to nanotech in major countries of six continents in the world thoroughly.

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## Fundamentals of Environment, Health and Safety Aspects

Natural Environment is full of beauty and hazards. The nature plays the role to the scavenger to nullify the impacts of the pollution thus generated. However, ever-increasing industrialization has been contributing pollution much beyond the assimilative capacity of the nature resulting in the degradation of the environment. Evidently, industry and environment are complementary to each other. The industries are required to grow to satisfy the need of the society but at the same time they need to do all this in an environmentally acceptable manner.

This book gives an overview of environment, health and safety aspects. Hazardous materials safety measures have been discussed thoroughly. What steps should be taken for betterment of community health and safety has explained. Impact of Environment and Health has been described thoroughly in this book.

**Chapter 1** describes about the environment health and safety aspects as factors affecting environment, procedures to improve the environment control system, tools (metrics) for measuring environmental performance, occupational health risks, hazardous materials, chemical properties and characteristic ,poisons and chemical compatibility in detail.

**Chapter 2** explains various hazardous materials safety measures as safe storage methods, housekeeping and hazard control methods, safe handling practices, Contingency plans and more. It presents review of hazardous materials properties and describes about how to responding to spills. Various steps to handle wastes and provide ambient air quality are explained thoroughly.

**Chapter 3** ensures about the better water quality and enough water availability with WHO guidelines. The important issues for structural safety of project infrastructure have discussed. For new buildings design and construction fire safety objectives as life and fire safety (L&FS) applicability and approach, fire prevention, means of egress, detection and alarm systems, Compartmentation, Fire Suppression and Control, Emergency Response Plan, Operation and Maintenance, L&FS Master Plan Review and Approval have been explained thoroughly. Traffic Safety, Management Actions, Preventive Measures, Disease Prevention & Communicable Diseases, Other Hazards topics have discussed in detail.

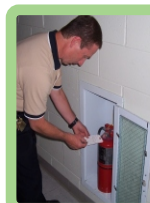
**Chapter 4** explains important topics as need for environmental and health impact, significance of environmental and health impact assessment, types of environmental and health hazards, environmental and health hazards identification, safety measures in factories, safety of building and machinery in detail.

The author attempts to make the study of the subject simple, relevant and interesting by presenting both basic concepts and advanced research findings in a lucid, practical manner.

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### Environment, Health & Safety Aspects



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## Environment, Health and Safety-Risk Assessment & Management

Risk assessment is the process of estimating the potential impact of a chemical, physical, microbiological or psychosocial hazard on a specified human population or ecological system under a specific set of conditions and for a certain timeframe. The process of formulating and implementing a course of action to mitigate hazards determined by risk assessment to be important.

This book presents Environment, Health and Safety risks assessment processes and methodology in detail. Risk assessment of various chemicals has been discussed thoroughly. Environment and Health risks and safety procedures have described. Risk management is most important area which have explained in this book.

**Chapter 1** presents an overview of the risk assessment. It explains the challenges for the risk assessment process, environmental health risk assessment methodology, key principles in environmental health risk assessment, types of risk assessment, process of risk assessment and the environmental risk analysis in detail.

**Chapter 2** explains thoroughly about tools and methods for risk assessment of various chemical as Chromium, Manganese, and Iron, Cobalt, Nickel, Copper, Arsenic, Selenium, Cadmium, Mercury and Lead. It also explain about the absorption.

**Chapter 3** provides important guidelines for food safety assessment, environmental risk assessment It explains other types of risks and resistance management. It ensures about the risk findings and decision-making. Foundations of the regulatory approach, risk management framework and fundamental concepts in risk management have been discussed in this chapter.

**Chapter 4** covers about risk management, objectives of the initiation step, preliminary analysis / risk identification, risk estimation, risk evaluation, risk control, implementation and monitoring in detail.

The author attempts to make the study of the subject simple, relevant and interesting by presenting both basic concepts and advanced research findings in a lucid, practical manner.

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### Environment, Health & Safety - Risk Assessment & Management



Manik Kalra

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# First Aid Services and Impact of Nanotechnology on Environment, Health & Safety

Nanotechnology is being hailed as the “next industrial revolution”. Nanomaterials are now found in hundreds of products, from cosmetics to clothing to food products. Inevitably, these nanomaterials will enter our bodies as we handle nanomaterials in the workplace, eat nano-foods, wear nano-clothes and nanocosmetics, use nano-appliances and dispose of nano waste into the environment. Early scientific studies demonstrate the potential for materials that are benign in bulk form to become harmful at the nanoscale. There is an urgent need for regulations to protect workers, the public and the environment from nanotoxicity's risks, for greater understanding of the short and long-term implications of nanotechnology for people's health and the environment, for consideration of nanotechnology's broader social implications and for public involvement in decision making regarding nanotechnology's introduction.

This book covers about health and safety services and health and environment implications of nanotechnology. Nanoscience and Nanotechnology: ethical, legal, social and environmental issues are being discussed in this book. Nanotechnology: opportunities and risks for human and the environment have described.

**Chapter 1** present health and safety services thoroughly. Sectors and activities regularly funded by the CERF grants, guidance on the health & safety (first aid) regulations 1981, first aid personnel and training, training, emergency response plan have discussed in detail in this chapter.

**Chapter 2** describes about nanotechnology and how it is used. it also explains nanofabrication nanomedicines, ultrasensitive pathogen quantification in drinking water using highly piezoelectric PMN-PT microcantilevers. Environmental benefits of nanoscale biopolymers for improved decontamination and recycling of heavy metals are discussed here. Important topics as Nanotechnology and environmental mitigation, health and environmental risks of nanotechnology explained very well. Potential applications of nanotechnology for environment and energy with examples of environmental nanotechnology have discussed. Survey on nanotechnology and environment have also described in this chapter.

**Chapter 3** discusses the Nanoscience and Nanotechnology: Ethical, Legal, Social and Environmental Issues in detail. It explains about health risks associated with nanomaterials, regulation of Nanomaterials. It also ensures about Nanotechnology: the possibility, the achievability, and the desirability. This chapter gives an overview of nanotechnology status in Asia-Pacific nations. Ethical issues of nanotechnology in the Asia-Pacific region have been discussed thoroughly.

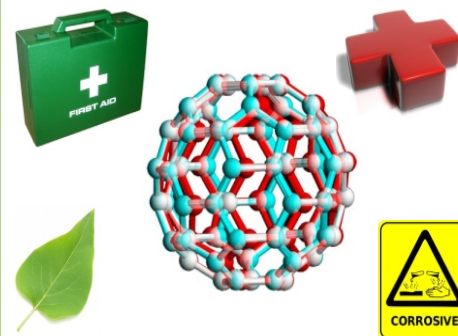
**Chapter 4** gives an overview of nanotechnology: opportunities and risks for humans and the environment. It explains some important topics as development and application fields of nanotechnology products, potential impact on humans and the environment: possible risks, exposure and persistence, health aspects of nano-sized particles, carbon nanotubes environmental implications, biomagnifications: risk for health, CT screening better than chest X-ray for reducing lung cancer mortality, alcoholism and PTSD thoroughly.

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## First Aid Services and Impact of Nanotechnology on Environment, Health & Safety



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## Health & Environment Regulations and Standards

Many of the industrially developed countries of the world have seen injury and illness rates decline over the last 50 years. However these rates have generally reached a plateau over the last decade. This fact, coupled with the realisation of the role of management and organisational (latent) failures in accident causation, has led to new approaches in managing health and safety, most notably the use of a systems approach. The importance of managing health and safety has been highlighted in recent official reports of major accidents and has received increasing emphasis in OH&S legislation.

This book describes in detail about environment & health ISO standards. It focuses on monitoring human health and environmental safety and child health & safety.

**Chapter 1** demonstrates ISO standards and private standards related to social and environmental aspects. BS OHSAS 18001 is a standard that specifies how an occupational safety and health management system should be designed is being described in this chapter. Key elements of a OH&S management system and practical aspects of OH&S management system have been explained thoroughly.

**Chapter 2** ensures the monitoring of human health and environment safety. It describes the methodology, recent international controversies and study initiative. It provides steps for promotion of safety measures with food to secure public health. Current use, research and impending development of foods produced through modern biotechnology are explained in detail. It identifies the risk of GMOS and GM foods to human health and the environment. Monitoring of human health and environmental safety, health indicators and data sources have been discussed in this chapter.

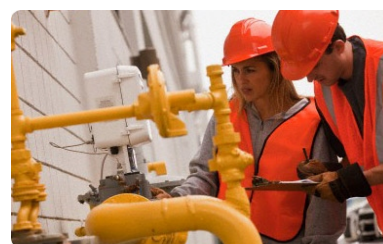
**Chapter 3** presents child health and safety. It explains use of performance and quality measurement, capitalizing on available data and data collection tools. In this chapter instructions for child care and about child health and safety have been discussed. It also gives an overview of children polices for health and safety ethical, legal, and social issues related to child health and safety, legal compliances involving children in detail.

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### Health & Environment Regulations & Standards



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# Profit From Nanotechnology

Nanotechnology brings new functions and properties to develop new products and applications in the industrial fields such as chemistry, medical technology, automobile, food industry, pharmacy, textile industry, environmental industry, and biotechnology where nano scale is so important.

Nanotechnology is an interdisciplinary science, which takes role in the material science, mechanics, electronics, optics, medicine, plastics, energy, aerospace, textiles, optical coatings, photovoltaic, antibacterial agents, physics, and biology.

Nanotechnology is forecasted to be a \$1 trillion industry by 2015. It is already revolutionizing important areas like medical science, electronics, computer science, textiles, robotics, and energy, manufacturing, chemicals, agriculture, etc. This book contains fascinating information on the effect of nanotechnology on 17 different disciplines. Every chapter consists of detailed aspects of nanotechnology including the present scenario, applications, prospects and information on some of the top companies with their coordinates and brief profiles of associated companies & institutions.

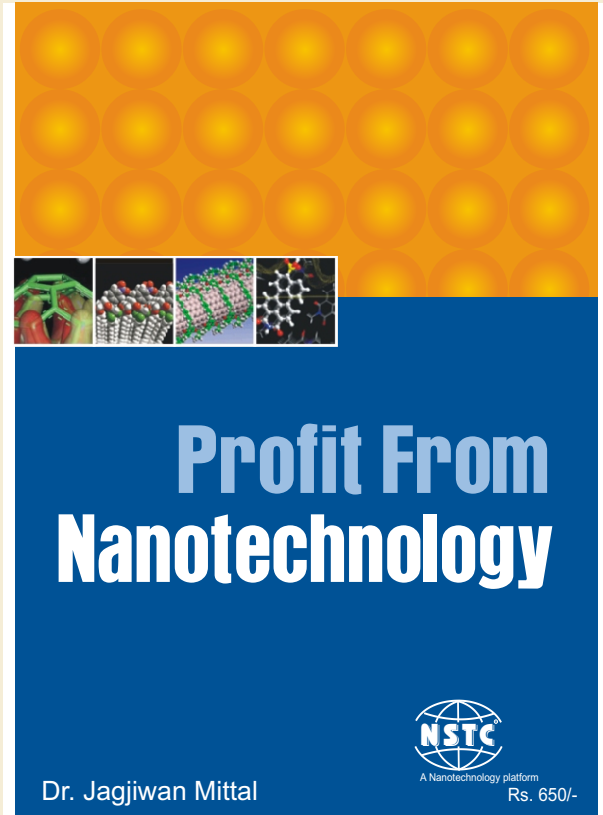
This book comprises of seventeen chapters. It describes the applications of nanotechnology in following sectors in details.

- Agriculture
- Environment
- Construction
- Textiles
- Manufacturing
- Energy
- Automobiles
- Chemicals
- Medicine
- Pharmaceuticals
- Marine
- Computers
- Electronics
- Nano Sensors
- Nano Robots
- Optics

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# Scientific & Technical Writing

Practice & Applications

This book presents the various practical exercises and applications in Scientific and Technical Writing domain. It practices on scientific research paper, Manuals, Reports, Proposals, Business Plans and Press Releases. Through this book reader can learn how to write official, casual letters and meeting documents. Researchers can learn how to write good thesis. It also explains about software requirements specifications and electronics documents. It practices on document design aspects and instructional design. It makes aware with selected relevant bodies, global conventions and norms concerning scientific technical writing & publishing, referencing. It also makes awareness in reader with ethical norms, rights and permission.

This book comprises of thirteen chapters.

**Chapter 1** practices on scientific research papers. It gives an overview of scientific research paper. It explains the step by step process to publish a scientific paper. What should be sections of a scientific paper have been discussed in this chapter.

**Chapter 2** gives an overview of instruction manual and user manual in detail.

**Chapter 3** defines the reports and explains their characteristics in detail. It gives overview of major categories of reports.

**Chapter 4** explains how to write proposals, business plans and press releases thoroughly.

**Chapter 5** explains about meeting documents. It includes how to write a minute and create an effective agenda.

**Chapter 6** describes about various kind of letters in detail.

**Chapter 7** describes about the thesis thoroughly. What should be steps to prepare god thesis have been discussed.

**Chapter 8** gives an overview of the software requirements specification.

**Chapter 9** explains about electronics documents as E-mail in detail. It also explains about online help and websites thoroughly.

**Chapter 10** presents document design aspects in detail.

**Chapter 11** focuses on instructional design and about their models in detail.

**Chapter 12** bring awareness in reader about relevant bodies of scientific technical writing, global conventions and norms concerning scientific technical writing and publishing, referencing.

**Chapter 13** explains about ethical norms, rights, and permissions of authors in detail.

The author attempts to make the study of the subject simple, relevant and interesting by presenting both basic concepts and advanced research findings in a lucid, practical manner.

**Nano Science & Technology Consortium (NSTC)** is a non-governmental, privately managed and promoted body. It aims to provide and facilitate in providing the services, that lead to awareness creation, research and development, consultancy, collaborations, technology transfer and commercialization in the field of Nanotechnology.

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Tel.: 0120 - 4781202, 204, 210 M: +91-9810078958 Website : [www.nstc.in](http://www.nstc.in) E-mail : [info@celnet.in](mailto:info@celnet.in)