ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

Multidisciplinary Courses Offered for B.A./B.Com./BBA/BCA Majors

w.e.f. AY 2023-24

SEMESTER-IV

INTRODUCTION TO NANOTECHNOLOGY

Credits: 2 2 hrs/week

Course Objective:

The objective of the course "Introduction to Nanotechnology" is to provide students with a comprehensive understanding of the principles, applications, and implications of nanotechnology from a multidisciplinary perspective.

Programme Outcomes:

By the end of the course, students will be able to:

1. Define and describe the fundamentals of nanotechnology: Students will develop a clear understanding of the basic concepts and principles of nanotechnology, including nanoscale materials, structures, and phenomena. They will grasp the unique properties and behavior of materials at the nanoscale and how they differ from macroscopic systems.

2. Understand the fabrication and characterization techniques in nanotechnology: Students will learn about the techniques and tools used to fabricate, manipulate, and characterize nanoscale materials and devices. They will explore techniques such as lithography, self-assembly, microscopy, spectroscopy, and nanofabrication methods.

3. Evaluate the ethical and societal implications of nanotechnology: Students will critically assess the ethical, social, and environmental implications of nanotechnology. They will explore issues related to privacy, health and safety, sustainability, and public perception, enabling them to make informed judgments and decisions regarding the responsible development and deployment of nanotechnology.

Syllabus:

Unit 1: Introduction to Nanotechnology

Overview of Nanotechnology: Definition, scope, and interdisciplinary nature of nanotechnology. Historical Development: Understanding the historical background and key milestones in the field of nanotechnology. Nanoscale Science: Introduction to the unique properties and phenomena at the nanoscale, including quantum effects and surface-to-volume ratio. Nanotechnology Applications:

Exploring the diverse range of applications of nanotechnology in various fields such as medicine, electronics, energy, and materials science.

Unit 2: Nanomaterials and Fabrication Techniques

Nanomaterials: Introduction to different types of nanomaterials, including nanoparticles, nanotubes, and nanocomposites. Understanding their synthesis, characterization, and properties. Top-Down Fabrication: Exploring top-down fabrication techniques, such as lithography and etching, used to create nanostructures and devices. Bottom-Up Fabrication: Introduction to bottom-up fabrication techniques, such as self-assembly and molecular nanotechnology, for the creation of nanoscale structures. Characterization Techniques: Overview of characterization techniques used to analyse and measure nanomaterials, including microscopy, spectroscopy, and diffraction methods.

Unit 3: Implications and Ethics of Nanotechnology

Environmental and Health Impacts: Understanding the potential environmental and health impacts of nanotechnology, including the risks associated with nanoparticles and nanomaterials. Ethical Considerations: Exploring ethical considerations related to nanotechnology, including privacy concerns, responsible research, and societal implications. Regulatory Framework: Introduction to the regulatory frameworks and safety standards for the development and commercialization of nanotechnology products. Future Perspectives: Discussing emerging trends, challenges, and future prospects in the field of nanotechnology, including advancements in nanomedicine, nanoelectronics, and nanomanufacturing.

Reference Books:

1. "Introduction to Nanotechnology" by Charles P. Poole Jr. and Frank J. Owens: This book provides a comprehensive introduction to the field of nanotechnology. It covers the basics of nanoscale science and engineering, fabrication techniques, nanomaterials, and various applications of nanotechnology.

2. "Nanotechnology: Principles and Applications" by Sulabha K. Kulkarni and Prakash C. Ghosh: This book offers an overview of the principles and applications of nanotechnology. It covers nanomaterials, nanofabrication methods, characterization techniques, and the role of nanotechnology in different sectors such as electronics, medicine, energy, and environmental remediation.

3. "Introduction to Nanoscience and Nanotechnology" by Gabor L. Hornyak, Joydeep Dutta, et al.: This textbook provides a comprehensive introduction to nanoscience and nanotechnology. It covers the fundamental concepts, fabrication techniques, characterization methods, and applications of nanotechnology. It also discusses societal and ethical considerations related to nanotechnology.

4. "Nanotechnology: Basic Science and Emerging Technologies" by Mick Wilson, Kamali Kannangara, et al.: This book presents the fundamental concepts and emerging technologies in nanotechnology. It covers nanoscale physics, chemistry, materials science, and engineering aspects of nanotechnology. It also explores the potential impact of nanotechnology on various fields, including medicine, electronics, and energy.

5. "Introduction to Nanotechnology" by Poole and Owens: This introductory textbook covers the basics of nanotechnology, including nanoscale phenomena, nanomaterials, fabrication techniques, and applications in electronics, medicine, and energy. It provides a solid foundation for understanding the principles and potential of nanotechnology.

Student Activity

1. Assign students to create a timeline that highlights the key milestones and discoveries in the field of nanotechnology. They should include significant events, breakthroughs, and contributions from different scientists and researchers. Encourage students to incorporate visuals and descriptions to depict the historical development of nanotechnology.

2. Organize a class discussion or debate where students compare and contrast top-down and bottom-up fabrication techniques for creating nanostructures and devices. Assign students to research and present the advantages, limitations, and real-world applications of each technique. Encourage students to critically analyze and discuss the suitability of each technique for different scenarios.

3. Assign students to research and prepare a report on the potential environmental and health impacts of nanotechnology. Students should explore the risks associated with nanoparticles and nanomaterials, such as their release into the environment, bioaccumulation, and potential toxicological effects. They should analyse case studies and scientific literature to assess the current understanding of these impacts and propose strategies for risk assessment and mitigation.