# GUJARAT TECHNOLOGICAL UNIVERSITY

## BE-7 SEMESTER – OLD PAPER – S22 TO S26 – QUESTION BANK

**Subject Name & Code:** Nanotechnology and Surface Engineering - 3171931

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## Chapter 1: Basic Elements of Nano-science and Nanotechnology

### Repeated Questions:

**1. Nanotechnology – Introduction, History & Scale:**

- **Q.** What is nanotechnology? Discuss its applications. **(SUMMER 2023, 3 Marks; WINTER 2023, 7 Marks; SUMMER 2024, 4 Marks; SUMMER 2025, 7 Marks; WINTER 2025, 4 Marks; SUMMER 2026, 3 Marks)**
- **Q.** Explain/Discuss the history of nanotechnology. **(SUMMER 2023, 4 Marks; SUMMER 2025, 4 Marks)**
- **Q.** Explain the engineering scale of nanotechnology. **(SUMMER 2025, 3 Marks; WINTER 2025, 3 Marks)**

**2. Importance, Role & Challenges:**

- **Q.** Explain the importance/role of nanoscience and nanotechnology. Discuss challenges. **(SUMMER 2022, 7 Marks; WINTER 2022, 7 Marks; WINTER 2025, 3 Marks)**

**3. Classes & Properties of Nanomaterials:**

- **Q.** Describe different classes of nano-materials. **(SUMMER 2022, 3 Marks; WINTER 2022, 3 Marks; WINTER 2024, 7 Marks; WINTER 2025, 7 Marks; SUMMER 2026, 4 Marks)**
- **Q.** Discuss the role of nano-size on material properties. **(WINTER 2022, 4 Marks; WINTER 2023, 3 Marks; WINTER 2024, 3 Marks)**
- **Q.** State different physical and chemical properties of nanomaterial. **(WINTER 2024, 4 Marks; WINTER 2025, 7 Marks)**

**4. Engineering Applications of Nanotechnology:**

- **Q.** Explain engineering applications in the field of Nano-sensors/Nano-catalysts/Food & Agriculture. **(WINTER 2023, 7 Marks - Food/Agri; WINTER 2024, 7 Marks - both options)**

### Other Important Questions:

**1. Basic Concepts:**

- **Q.** What do you mean by nanoscience? **(SUMMER 2024, 4 Marks)**

**2. Role & Applications of Nanotechnology:**

- **Q.** Discuss the usefulness of nanotechnology in surface engineering. **(SUMMER 2022, 4 Marks)**
- **Q.** Discuss the role of nanomaterials in the advancement of society. **(WINTER 2024, 3 Marks)**
- **Q.** Define nanotechnology. Write a note on nano sensors. Give applications. **(WINTER 2023, 7 Marks)**
- **Q.** Explain engineering applications of nanoscience and nanotechnology in the field of cosmetics and consumer goods industry. **(SUMMER 2026, 7 Marks)**

**3. Surface Area of Nanomaterials (Mathematical Proof):**

- **Q.** Prove mathematically: “Nanomaterials possess more surface area than normal materials.” **(WINTER 2025, 4 Marks)**

## Chapter 2: Nanotechnology and Ceramics (Synthesis Methods)

### Repeated Questions:

**1. Vapor Condensation Method:**

- **Q.** Explain the Vapor Condensation Method. **(SUMMER 2022, 7 Marks; WINTER 2022, 7 Marks; SUMMER 2024, 4 Marks; SUMMER 2025, 4 Marks; WINTER 2025, 7 Marks; SUMMER 2026, 7 Marks)**

**2. Spray Pyrolysis:**

- **Q.** Explain Spray Pyrolysis. **(SUMMER 2022, 3 Marks; WINTER 2022, 4 Marks; SUMMER 2023, 3 Marks; WINTER 2024, 3 Marks - advantages/disadvantages)**
- **Q.** Explain Flame Spray Pyrolysis. **(SUMMER 2024, 7 Marks; SUMMER 2025, 7 Marks)**

**3. Top-Down and Bottom-Up Approaches:**

- **Q.** Compare Top-Down and Bottom-Up approaches. **(SUMMER 2022, 4 Marks; WINTER 2022, 4 Marks; SUMMER 2023, 4 Marks; WINTER 2023, 7 Marks; WINTER 2024, 3 Marks; SUMMER 2025, 3 Marks; WINTER 2025 OR; SUMMER 2026, 4 Marks)**

**4. Sputtering:**

- **Q.** Explain Sputtering. **(SUMMER 2023, 4 Marks; WINTER 2023, 4 Marks; WINTER 2024, 4 Marks - RF Sputtering; WINTER 2025, 4 Marks)**

**5. Chemical Vapour Deposition (CVD):**

- **Q.** Explain Chemical Vapour Deposition (CVD). **(SUMMER 2023, 7 Marks; WINTER 2024, 7 Marks)**

**6. Sol-Gel Method:**

- **Q.** Explain sol-gel process. / Explain synthesis of nanomaterial by sol-gel method. **(SUMMER 2023, 3 Marks; WINTER 2024, 7 Marks)**

**7. Classification of Synthesis Methods:**

- **Q.** Classify methods for synthesis of nano materials. **(SUMMER 2024, 3 Marks; SUMMER 2025, 3 Marks; SUMMER 2026, 3 Marks)**

### Other Important Questions:

**1. Fabrication Approaches & Mechanical Techniques:**

- **Q.** Explain fabrication approaches of nanomaterials. **(SUMMER 2023, 7 Marks)**
- **Q.** Which are the mechanical techniques for fabrication of nanomaterials? Explain any one. **(SUMMER 2023, 7 Marks)**
- **Q.** Explain synthesis of nanomaterials by high energy ball milling along with its advantages and disadvantages. **(WINTER 2025, 7 Marks OR)**

**2. Lithography & Laser Methods:**

- **Q.** Briefly explain photolithography. **(SUMMER 2024, 7 Marks)**
- **Q.** Explain laser ablation method. **(SUMMER 2023, 7 Marks)**

**3. Other Chemical Synthesis Methods:**

- **Q.** Explain flame decomposition of metal organic precursors method. **(WINTER 2024, 4 Marks)**
- **Q.** Explain the principle of hydrothermal method for synthesis of nanomaterials. **(WINTER 2025 OR)**

**4. Synthesis Techniques – General:**

- **Q.** List different techniques of nanomaterial synthesis. Explain any one. **(WINTER 2023, 7 Marks)**

**5. Classification of CVD Processes:**

- **Q.** Give a classification of different CVD processes. **(SUMMER 2026, 4 Marks)**

## Chapter 3: Tools to Characterize Nanomaterials

### Repeated Questions:

**1. Scanning Electron Microscopy (SEM):**

- **Q.** Explain Scanning Electron Microscopy (SEM). **(WINTER 2022, 7 Marks; SUMMER 2023, 7 Marks; SUMMER 2024, 7 Marks; SUMMER 2025, 7 Marks)**
- **Q.** Discuss advantages and limitations of SEM. **(WINTER 2023, 3 Marks; WINTER 2024, 4 Marks)**

**2. Transmission Electron Microscopy (TEM):**

- **Q.** Explain Transmission Electron Microscopy (TEM). [Diagram required – refer to the original question paper of WINTER 2025] **(WINTER 2022, 7 Marks; SUMMER 2023, 7 Marks; SUMMER 2024, 7 Marks; SUMMER 2025, 7 Marks; WINTER 2025 OR; SUMMER 2026, 7 Marks)**

**3. Atomic Force Microscopy (AFM):**

- **Q.** Explain Atomic Force Microscopy (AFM). **(WINTER 2022, 3 Marks; SUMMER 2023, 3 Marks; SUMMER 2024, 4 Marks; WINTER 2024, 7 Marks; SUMMER 2026, 7 Marks OR)**

**4. X-Ray Diffraction (XRD) & Bragg's Law:**

- **Q.** Explain X-Ray Diffraction (XRD). / State advantages and applications of XRD. **(SUMMER 2022, 4 Marks; WINTER 2022, 7 Marks; SUMMER 2025, 7 Marks; WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks)**
- **Q.** Explain Bragg's law. **(SUMMER 2022, 3 Marks; WINTER 2022, 3 Marks; WINTER 2025, 3 Marks OR; SUMMER 2026, 4 Marks)**

**5. UV-Visible Spectroscopy:**

- **Q.** Explain UV-Visible Spectroscopy. **(SUMMER 2022, 7 Marks; WINTER 2022, 7 Marks; SUMMER 2023, 4 Marks; SUMMER 2025, 7 Marks; WINTER 2025, 3 Marks)**

**6. Comparison of Microscopy Techniques:**

- **Q.** Differentiate between SEM and TEM. **(SUMMER 2022, 4 Marks; SUMMER 2023, 4 Marks; WINTER 2023, 3 Marks; SUMMER 2026, 4 Marks OR)**

**7. Characterization Tools – General:**

- **Q.** Enlist different tools used in characterization of nanomaterials. **(SUMMER 2022, 3 Marks; WINTER 2022, 7 Marks; SUMMER 2025, 7 Marks; SUMMER 2026, 3 Marks OR)**

### Other Important Questions:

**1. Comparison of AFM, SEM and TEM:**

- **Q.** What are the differences between AFM, SEM, and TEM? **(SUMMER 2023, 4 Marks)**

**2. TEM – Advantages, Applications & Sample Requirement:**

- **Q.** State advantages, disadvantages, and applications of TEM. **(WINTER 2024, 4 Marks)**
- **Q.** What is sample requirement in TEM? **(WINTER 2023, 3 Marks)**

**3. AFM – Sample Preparation:**

- **Q.** Explain briefly sample preparation techniques for AFM. **(WINTER 2023, 4 Marks)**

**4. XRD – Usefulness:**

- **Q.** What is XRD? How is it useful in nanomaterial characterization? **(WINTER 2023, 7 Marks)**

**5. Basic Terminology:**

- **Q.** Write full form of: SEM, AFM, TEM, and XRD. **(WINTER 2024, 4 Marks)**

## Chapter 4: Surface Engineering (Introduction, Preparation, Coatings)

### Repeated Questions:

**1. Introduction to Surface Engineering:**

- **Q.** What do you mean by Surface Engineering? **(WINTER 2022, 3 Marks; SUMMER 2024, 3 Marks; SUMMER 2025, 3 Marks; SUMMER 2026, 3 Marks)**

**2. Surface Preparation & Cleaning Methods:**

- **Q.** Explain Shot Peening / Shot Blasting process. [Diagram required – refer to the original question paper of SUMMER 2026] **(SUMMER 2022, 7 Marks; WINTER 2023, 4 Marks; WINTER 2023, 7 Marks; SUMMER 2024, 7 Marks; SUMMER 2026, 7 Marks OR)**
- **Q.** Explain Sand Blasting method. **(WINTER 2022, 3 Marks; SUMMER 2023, 4 Marks; SUMMER 2026, 7 Marks)**
- **Q.** Explain Surface Preparation by Electrochemical method. **(SUMMER 2024, 7 Marks; SUMMER 2025, 7 Marks)**
- **Q.** Explain Vapor Phase Degreasing. **(WINTER 2022, 4 Marks; WINTER 2023, 4 Marks)**

**3. Coatings – Classification, Properties & Applications:**

- **Q.** Classify Coatings / Nano Coatings. State applications. **(SUMMER 2023, 4 Marks; WINTER 2023, 3 Marks; SUMMER 2024, 3 Marks; SUMMER 2025, 3 Marks; SUMMER 2025, 4 Marks; WINTER 2025, 7 Marks)**
- **Q.** Describe the applications of coatings. **(SUMMER 2024, 4 Marks; SUMMER 2025, 4 Marks)**
- **Q.** Describe different properties required for coating. **(SUMMER 2024, 4 Marks; SUMMER 2025, 4 Marks)**

**4. Coating Defects:**

- **Q.** State and explain different coating defects. **(SUMMER 2022, 4 Marks; WINTER 2022, 4 Marks; SUMMER 2025, 4 Marks)**

**5. Aluminium Coating vs Cadmium Plating:**

- **Q.** Compare aluminum coating and cadmium plating. **(SUMMER 2022, 4 Marks; WINTER 2022, 4 Marks)**

### Other Important Questions:

**1. Importance & Scope of Surface Engineering:**

- **Q.** Explain the importance of surface engineering. **(WINTER 2023, 3 Marks)**
- **Q.** Discuss the scope of surface engineering for different engineering materials. **(WINTER 2024, 3 Marks)**

**2. Importance & Advantages of Surface Coating:**

- **Q.** State the importance of surface coating. **(SUMMER 2022, 3 Marks)**
- **Q.** State the advantages of surface coating. **(WINTER 2024, 3 Marks)**
- **Q.** What is nano coating? **(WINTER 2022, 3 Marks)**

**3. Surface Preparation & Cleaning Methods:**

- **Q.** Explain Hydro blasting process. **(SUMMER 2023, 7 Marks)**
- **Q.** What is electro chemical surface preparation? **(SUMMER 2023, 3 Marks)**
- **Q.** Explain the need for cleaning and surface preparation of metal surfaces before coating. **(WINTER 2025)**
- **Q.** Differentiate between shot blasting and sand blasting. **(WINTER 2025, 4 Marks OR)**
- **Q.** List six methods used for cleaning and surface preparation of metal surfaces before coating. Explain any one in detail. **(WINTER 2025, 7 Marks OR)**

**4. Electroplating & Galvanizing:**

- **Q.** Explain advantages and disadvantages of electroplating. **(WINTER 2025, 4 Marks)**
- **Q.** Illustrate with a neat sketch electroplating process. [Diagram required – refer to the original question paper of SUMMER 2026] **(SUMMER 2026, 4 Marks)**
- **Q.** Illustrate with a neat sketch galvanizing process. [Diagram required – refer to the original question paper of SUMMER 2026] **(SUMMER 2026, 4 Marks OR)**

**5. Powder Coating:**

- **Q.** Write the advantages, disadvantages and applications of powder coating. **(WINTER 2025 OR)**

**6. Ion Vapour Deposition (IVD) Coatings:**

- **Q.** What are the important properties of IVD coatings? **(SUMMER 2026, 3 Marks)**
- **Q.** What is IVD? Explain the working principle of IVD with a neat sketch. [Diagram required – refer to the original question paper of SUMMER 2026] **(SUMMER 2026, 7 Marks)**
- **Q.** Explain the steps to be followed for the IVD aluminium process. **(SUMMER 2026, 4 Marks OR)**

## Chapter 5: Different Methods for Surface Modifications

### Repeated Questions:

**1. Classification & Need of Surface Modification:**

- **Q.** Enlist/Classify different methods for surface modification. **(SUMMER 2022, 3 Marks; WINTER 2022, 3 Marks; SUMMER 2024, 3 Marks; WINTER 2024, 3 Marks; SUMMER 2025, 3 Marks; SUMMER 2026, 3 Marks OR)**
- **Q.** Why is Surface Modification required? **(SUMMER 2024, 3 Marks; SUMMER 2025, 3 Marks; WINTER 2025, 3 Marks OR)**

**2. Ion Implantation:**

- **Q.** Explain Surface Modification by Ion Implantation. **(WINTER 2023, 7 Marks; SUMMER 2024, 7 Marks; SUMMER 2025, 7 Marks; WINTER 2025, 7 Marks OR; SUMMER 2026, 3 Marks OR)**

**3. Plasma Surface Modification:**

- **Q.** Explain Surface Modification by Plasma. **(SUMMER 2024, 7 Marks; SUMMER 2025, 7 Marks)**

**4. Friction Stir Processing:**

- **Q.** Explain Friction Stir Processing. **(WINTER 2022, 7 Marks; WINTER 2023, 7 Marks; WINTER 2024, 7 Marks; SUMMER 2026, 7 Marks OR)**

**5. Laser and Electron Beam Techniques:**

- **Q.** Discuss surface modification techniques using laser. **(SUMMER 2022, 7 Marks; WINTER 2025, 7 Marks)**
- **Q.** Explain electron beam lithography. **(WINTER 2022, 7 Marks; SUMMER 2023, 7 Marks)**

**6. Case Study:**

- **Q.** Explain one case study based on Surface modification/Nano coating of an engineering component. **(SUMMER 2024, 4 Marks; SUMMER 2025, 4 Marks)**

### Other Important Questions:

**1. Surface Composites:**

- **Q.** What are surface composites? Explain how they differ from normal composites. **(WINTER 2023, 4 Marks)**
- **Q.** Discuss the importance of surface composite in engineering application. **(WINTER 2022, 3 Marks)**

**2. Ion Implantation – Definition, Use & Merits:**

- **Q.** What is ion implantation? Describe its use in surface modification. **(WINTER 2023, 7 Marks)**
- **Q.** State advantages and disadvantages of Ion Implantation. **(WINTER 2024, 4 Marks)**
- **Q.** Define: Ion implantation, Plasma nitriding, Anodizing. **(SUMMER 2022, 3 Marks)**

**3. PVD, CVD & Sputtering:**

- **Q.** Compare CVD and PVD. **(SUMMER 2022, 3 Marks)**
- **Q.** State advantages and disadvantages of Physical Vapour Deposition. **(WINTER 2024, 4 Marks)**
- **Q.** Explain sputtering and ion implantation. **(SUMMER 2023, 4 Marks)**

**4. Laser & Directed Energy Beam Methods:**

- **Q.** List three different types of laser surface modification techniques. **(WINTER 2024, 3 Marks)**
- **Q.** Explain surface modification by use of directed energy beams. **(WINTER 2024, 7 Marks)**

**5. Friction Stir Welding (FSW):**

- **Q.** Explain the working principle of FSW process. **(SUMMER 2022, 7 Marks)**
- **Q.** List the applications of friction stir welding in different fields. **(WINTER 2025, 3 Marks)**

## Chapter 6: Case Studies

### Repeated Questions:

**1. Case Studies on Coatings:**

- **Q.** Explain one case study based on Nano coating of engineering component. **(SUMMER 2024, 4 Marks; SUMMER 2025, 4 Marks)**

### Other Important Questions:

**1. Case Studies on Surface Modification:**

- **Q.** Explain one case study based on Surface modification of engineering component. **(SUMMER 2024, 4 Marks)**

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