

GUJARAT TECHNOLOGICAL UNIVERSITY

BE-7 SEMESTER – OLD PAPER – S22 TO S25 – QUESTION BANK

Subject Name & Code:

Nanotechnology and surface Engineering- 3171931

Unit 1: Basic Elements of Nano-science and Nanotechnology

Repeated Questions:

- **What is nanotechnology? Discuss its applications.**
 - **Appeared in:** Summer 2023 (Q1a, 03 Marks), Summer 2024 (Q1b, 04 Marks), Winter 2023 (Q3c, 07 Marks), Summer 2025 (Q1c, 07 Marks)
- **Explain/Discuss the history of nanotechnology.**
 - **Appeared in:** Summer 2023 (Q1b, 04 Marks), Summer 2025 (Q1b, 04 Marks)
- **Explain the importance/role of nanoscience and nanotechnology. Discuss challenges.**
 - **Appeared in:** Winter 2022 (Q1c, 07 Marks), Summer 2022 (Q1c, 07 Marks)
- **Describe different classes of nano-materials.**
 - **Appeared in:** Winter 2022 (Q1a, 03 Marks), Summer 2022 (Q1a, 03 Marks), Winter 2024 (Q1c, 07 Marks)
- **Discuss the role of nano-size on material properties.**
 - **Appeared in:** Winter 2022 (Q1b, 04 Marks), Winter 2023 (Q3a, 03 Marks), Winter 2024 (Q1a, 03 Marks)
- **Explain engineering applications in the field of Nano-sensors/Nano-catalysts/Food & Agriculture.**
 - **Appeared in:** Winter 2023 (Q3c - Food/Agri, 07 Marks), Winter 2024 (Q2c, 07 Marks - both options)

Other Important Questions:

- What do you mean by nanoscience? (Summer 2024, Q1b, 04 Marks)
- Discuss the usefulness of nanotechnology in surface engineering. (Summer 2022, Q1b, 04 Marks)
- Discuss the role of nanomaterials in the advancement of society. (Winter 2024, Q2a, 03 Marks)
- Define nanotechnology. Write a note on nano sensors. Give applications. (Winter 2023, Q3c, 07 Marks)
- State different physical and chemical properties of nanomaterial. (Winter 2024, Q1b, 04 Marks)
- Explain the engineering scale of nanotechnology. (Summer 2025, Q1a, 03 Marks)

Unit 2: Nanotechnology and Ceramics (Synthesis Methods)

Repeated Questions:

- **Explain the Vapor Condensation Method.**
 - **Appeared in:** Summer 2024 (Q2b, 04 Marks), Summer 2025 (Q2b, 04 Marks), Winter 2022 (Q3c, 07 Marks), Summer 2022 (Q2c, 07 Marks)
- **Explain Spray Pyrolysis.**
 - **Appeared in:** Summer 2023 (Q4a, 03 Marks), Winter 2022 (Q3b, 04 Marks), Summer 2022 (Q2a, 03 Marks), Winter 2024 (Q3a - advantages/disadvantages, 03 Marks)
- **Compare Top-Down and Bottom-Up approaches.**
 - **Appeared in:** Summer 2023 (Q4b, 04 Marks), Winter 2022 (Q2b, 04 Marks), Summer 2022 (Q2b, 04 Marks), Winter 2023 (Q2c, 07 Marks), Winter 2024 (Q3a, 03 Marks), Summer 2025 (Q4a, 03 Marks)
- **Explain Sputtering.**
 - **Appeared in:** Summer 2023 (Q5b, 04 Marks), Winter 2023 (Q4b, 04 Marks), Winter 2024 (Q3b - RF Sputtering, 04 Marks)
- **Explain Chemical Vapour Deposition (CVD).**
 - **Appeared in:** Summer 2023 (Q1c, 07 Marks), Winter 2024 (Q3c, 07 Marks)

Other Important Questions:

- Explain fabrication approaches of nanomaterials. (Summer 2023, Q1c, 07 Marks)
- Which are the mechanical techniques for fabrication of nanomaterials? Explain any one. (Summer 2023, Q3c, 07 Marks)
- Explain sol-gel process. (Summer 2023, Q3a, 03 Marks)
- Explain laser ablation method. (Summer 2023, Q2c, 07 Marks)
- Briefly explain photolithography. (Summer 2024, Q2c, 07 Marks)
- Explain Flame Spray Pyrolysis. (Summer 2024, Q2c, 07 Marks; Summer 2025, Q2c, 07 Marks)
- Explain flame decomposition of metal organic precursors method. (Winter 2024, Q3b, 04 Marks)
- Explain synthesis of nanomaterial by sol-gel method. (Winter 2024, Q3c, 07 Marks)
- Classify methods for synthesis of nano materials. (Summer 2024, Q4a, 03 Marks; Summer 2025, Q4a, 03 Marks)
- List different techniques of nanomaterial synthesis. Explain any one. (Winter 2023, Q2c, 07 Marks)

Unit 3: Tools to Characterize Nanomaterials

Repeated Questions:

- **Explain Scanning Electron Microscopy (SEM).**
 - **Appeared in:** Summer 2023 (Q2c, 07 Marks), Winter 2022 (Q2c, 07 Marks), Summer 2024 (Q3c, 07 Marks), Summer 2025 (Q3c, 07 Marks)
- **Explain Transmission Electron Microscopy (TEM).**
 - **Appeared in:** Summer 2023 (Q4c, 07 Marks), Summer 2024 (Q3c, 07 Marks), Winter 2022 (Q3c, 07 Marks), Summer 2025 (Q3c, 07 Marks)
- **Explain Atomic Force Microscopy (AFM).**
 - **Appeared in:** Summer 2023 (Q2a, 03 Marks), Winter 2022 (Q3a, 03 Marks), Summer 2024 (Q3b, 04 Marks), Winter 2024 (Q4c, 07 Marks)
- **Explain X-Ray Diffraction (XRD). / State advantages and applications of XRD.**
 - **Appeared in:** Winter 2022 (Q2c, 07 Marks), Summer 2022 (Q3b, 04 Marks), Summer 2025 (Q2c, 07 Marks)
- **Differentiate between SEM and TEM.**
 - **Appeared in:** Summer 2023 (Q2b, 04 Marks), Summer 2022 (Q3b, 04 Marks), Winter 2023 (Q4a, 03 Marks)
- **Explain UV-Visible Spectroscopy.**
 - **Appeared in:** Summer 2023 (Q3b, 04 Marks), Winter 2022 (Q4c, 07 Marks), Summer 2022 (Q3c, 07 Marks), Summer 2025 (Q4c, 07 Marks)

Other Important Questions:

- What are the differences between AFM, SEM, and TEM? (Summer 2023, Q2b, 04 Marks)
- Explain Bragg's law. (Winter 2022, Q2a, 03 Marks; Summer 2022, Q3a, 03 Marks)
- Enlist different tools used in characterization of nanomaterials. (Winter 2022, Q2c, 07 Marks; Summer 2022, Q3a, 03 Marks; Summer 2025, Q2c, 07 Marks)
- Write full form of: SEM, AFM, TEM, and XRD. (Winter 2024, Q2b, 04 Marks)
- Discuss advantages and limitations of SEM. (Winter 2023, Q4a, 03 Marks; Winter 2024, Q4b, 04 Marks)
- State advantages, disadvantages, and applications of TEM. (Winter 2024, Q4b, 04 Marks)
- What is XRD? How is it useful in nanomaterial characterization? (Winter 2023, Q4c, 07 Marks)
- What is sample requirement in TEM? (Winter 2023, Q5a, 03 Marks)
- Explain briefly sample preparation techniques for AFM. (Winter 2023, Q3b, 04 Marks)

Unit 4: Surface Engineering (Introduction, Preparation, Coatings)

Repeated Questions:

- **What do you mean by Surface Engineering?**
 - **Appeared in:** Summer 2024 (Q3a, 03 Marks), Winter 2022 (Q4a, 03 Marks), Summer 2025 (Q3a, 03 Marks)
- **Explain Shot Peening / Shot Blasting process.**
 - **Appeared in:** Winter 2023 (Q1b, 04 Marks; Q1c, 07 Marks), Summer 2024 (Q4c, 07 Marks), Summer 2022 (Q4c, 07 Marks)
- **Classify Coatings / Nano Coatings. State applications.**
 - **Appeared in:** Summer 2024 (Q3a, 03 Marks), Winter 2023 (Q2a, 03 Marks), Summer 2023 (Q5b, 04 Marks), Summer 2025 (Q3a, 03 Marks; Q4b, 04 Marks)
- **State and explain different coating defects.**
 - **Appeared in:** Winter 2022 (Q4b, 04 Marks), Summer 2022 (Q4b, 04 Marks), Summer 2025 (Q3b, 04 Marks)
- **Explain Surface Preparation by Electrochemical method.**
 - **Appeared in:** Summer 2024 (Q4c, 07 Marks), Summer 2025 (Q4c, 07 Marks)
- **Explain Vapor Phase Degreasing.**
 - **Appeared in:** Winter 2023 (Q2b, 04 Marks), Winter 2022 (Q5b, 04 Marks)

Other Important Questions:

- Explain the importance of surface engineering. (Winter 2023, Q1a, 03 Marks)
- Discuss the scope of surface engineering for different engineering materials. (Winter 2024, Q4a, 03 Marks)
- State the importance of surface coating. (Summer 2022, Q4a, 03 Marks)
- State the advantages of surface coating. (Winter 2024, Q4a, 03 Marks)
- Describe the applications of coatings. (Summer 2024, Q4b, 04 Marks; Summer 2025, Q4b, 04 Marks)
- Describe different properties required for coating. (Summer 2024, Q4b, 04 Marks; Summer 2025, Q4b, 04 Marks)
- Explain Sand Blasting method. (Winter 2022, Q3a, 03 Marks; Summer 2023, Q3b, 04 Marks)
- Explain Hydro blasting process. (Summer 2023, Q4c, 07 Marks)
- Compare aluminum coating and cadmium plating. (Winter 2022, Q4b, 04 Marks; Summer 2022, Q4b, 04 Marks)
- What is electro chemical surface preparation? (Summer 2023, Q5a, 03 Marks)
- What is nano coating? (Winter 2022, Q4a, 03 Marks)

Unit 5: Different Methods for Surface Modifications

Repeated Questions:

- **Enlist/Classify different methods for surface modification.**
 - **Appeared in:** Summer 2024 (Q5a, 03 Marks), Winter 2022 (Q5a, 03 Marks), Summer 2022 (Q4a, 03 Marks), Winter 2024 (Q5a, 03 Marks), Summer 2025 (Q5a, 03 Marks)
- **Explain Surface Modification by Ion Implantation.**
 - **Appeared in:** Summer 2024 (Q5c, 07 Marks), Winter 2023 (Q5c, 07 Marks), Summer 2025 (Q5c, 07 Marks)
- **Explain Surface Modification by Plasma.**
 - **Appeared in:** Summer 2024 (Q5c, 07 Marks), Summer 2025 (Q5c, 07 Marks)
- **Explain Friction Stir Processing.**
 - **Appeared in:** Winter 2023 (Q5c, 07 Marks), Winter 2022 (Q5c, 07 Marks), Winter 2024 (Q5c, 07 Marks)
- **Why is Surface Modification required?**
 - **Appeared in:** Summer 2024 (Q5a, 03 Marks), Summer 2025 (Q5a, 03 Marks)

Other Important Questions:

- What are surface composites? Explain how they differ from normal composites. (Winter 2023, Q5b, 04 Marks)
- Discuss the importance of surface composite in engineering application. (Winter 2022, Q5a, 03 Marks)
- Explain one case study based on Surface modification/Nano coating of an engineering component. (Summer 2024, Q5b, 04 Marks; Summer 2025, Q5b, 04 Marks)
- Explain sputtering and ion implantation. (Summer 2023, Q5b, 04 Marks)
- What is ion implantation? Describe its use in surface modification. (Winter 2023, Q5c, 07 Marks)
- Define: Ion implantation, Plasma nitriding, Anodizing. (Summer 2022, Q5a, 03 Marks)
- Compare CVD and PVD. (Summer 2022, Q5a, 03 Marks)
- Discuss surface modification techniques using laser. (Summer 2022, Q5c, 07 Marks)
- List three different types of laser surface modification techniques. (Winter 2024, Q5a, 03 Marks)
- Explain surface modification by use of directed energy beams. (Winter 2024, Q5c, 07 Marks)
- State advantages and disadvantages of Ion Implantation. (Winter 2024, Q5b, 04 Marks)
- State advantages and disadvantages of Physical Vapour Deposition. (Winter 2024, Q5b, 04 Marks)
- Explain the working principle of FSW process. (Summer 2022, Q5c, 07 Marks)
- Explain electron beam lithography. (Winter 2022, Q5c, 07 Marks; Summer 2023, Q5c, 07 Marks)

Unit 6: Case Studies

- **Note:** This unit is specifically assessed through case study questions. The questions from other units, particularly under "Surface Modification" and "Coatings," often serve as de facto case studies.

Questions from this unit:

- **Explain one case study based on Surface modification of engineering component.**
 - **Appeared in:** Summer 2024 (Q5b, 04 Marks)
- **Explain one case study based on Nano coating of engineering component.**
 - **Appeared in:** Summer 2024 (Q5b, 04 Marks), Summer 2025 (Q5b, 04 Marks)

Preparation Tip: For this unit, you should prepare 2-3 generic but detailed case studies. For example:

1. **Nano-coating for Gas Turbine Blades:** Discuss the problem (high-temperature corrosion), the solution (application of a Thermal Barrier Coating like YSZ using Plasma Spray), and the merits (increased lifespan, efficiency).
2. **Surface Modification for Artificial Hip Implants:** Discuss the problem (biocompatibility, wear), the solution (surface modification using Plasma Spray or Ion Implantation to create a porous or hydroxyapatite coating), and the merits (better osseointegration, reduced wear debris).
