

GOVERNMENT OF GUJARAT
LUKHDHIRJI ENGINEERING COLLEGE, MORBI
Mechanical Engineering Department

Subject: Nanotechnology and Surface Engineering(3171931)

Class: 7th Semester

Assignment 1: Basic Elements of Nano-science and Nanotechnology (CO1)

- Q.1 Enlist different classes of nano-materials. Explain engineering scale of nano technology.
- Q.2 State the importance of nanomaterials and nanotechnology.
- Q.3 Discuss the various applications of nanotechnology in cosmetics and consumer goods.
- Q.4 Explain the effect of nanometer length scale on diffusivity, melting point and solubility of materials.
- Q.5 Briefly explain which properties of materials enhance at nano scale.

Assignment 2: Nanotechnology and Ceramics (CO2)

- Q.1 Compare the ‘top-down’ and ‘bottom-up’ approaches for the synthesis of nanomaterials.
- Q.2 Discuss the principle and applications of vapor condensation method for nano materials synthesis.
- Q.3 List out various parameters associated with electrospinning technique for synthesis of nanofiber.
- Q.4 Describe the distinctive features of a self-assembled nanostructure.
- Q.5 With schematic diagram, explain the principle of lithographic process. Can lithography be considered as a combination of top down and bottom up approach? Why?

1 Vision of the Department:

To deliver quality engineering education for Mechanical Engineers with Professional competency, Human values and Acceptability in the society.

Mission of the Department:

- To nurture engineers with basic and advance mechanical engineering concepts
- To impart Techno-Managerial skill in students to meet global engineering challenges
- To create ethical engineers who can contribute for sustainable development of society

Assignment 3: Tools to Characterize Nanomaterials (CO3)

- Q.1 Compare the salient features of scanning electron microscopy and transmission electron microscopy.
- Q.2 Select an appropriate technique for characterization of a fractures sample and explain the technique.
- Q.3 FCC copper has a cubic lattice constant value $a=3.6\text{\AA}$. Determine the d-spacing of the (200) Bragg reflection?
- Q.4 The Bragg angle corresponding to the first order reflection from (111) planes of a crystal is 30 degrees, when X-rays of wavelength 1.75\AA are used. Calculate the interplanar spacing?
- Q.5 Write down the advantages and disadvantages of each mode of AFM.
- Q.6 Explain theory and working principle of UV-Vis Spectroscopy.

Assignment 4: Surface Engineering (CO4)

- Q.1 Explain the significance of surface coating.
- Q.2 Why surface preparation is important before coating?
- Q.3 Classify different surface modification or coating methods.
- Q.4 Illustrate with neat sketch, Explain electroplating process.
- Q.5 Explain shot blasting process with neat sketch. Also state its applications.
- Q.6 Distinguish shot blasting and sand blasting.
- Q.7 List the different coating defects, their causes and remedies.

Assignment 5: Different Methods for Surface Modifications (CO5)

- Q.1 What is PVD ? Explain in details.
- Q.2 What is CVD ? Explain with suitable sketch.
- Q.3 What is IVD ? Explain with neat sketch.
- Q.4 Distinguish between PVD and CVD.
- Q.5 What are the steps to be followed for IVD aluminium process.
- Q.6 Explain the working or ion implantation with neat sketch. Also state its merits, demerits and applications.
- Q.7 Distinguish between aluminium coating and cadmium plating.
- Q.8 Describe FSW process with neat sketch. Also state its applications.
- Q.9 List important properties of IVD coatings.
- Q.10 Discuss principle of sputter deposition with neat sketch. Also state its merits and demerits.
- Q.11 Explain plasma surface modification process.

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CASE STUDIES (CO4/CO5)

1. Select an appropriate coating/ surface modification method for a cylindrical steel (grade SS 310S) pressure vessel of 1000 mm \varnothing X 4000 mm length with a wall thickness of 15 mm. The vessel works on room temperature and subjected to an internal pressure of 4.5 MPa.
 - a) Enlist the criteria based on which you want to suggest the coating/surface modification method for above case.
 - b) Proposed a method and give justification.
 - c) Write the process parameters which one should control for proposed method.
 - d) What are the changes you expecting in pressure vessel performance after employing proposed coating/ surface modification method?
 - e) Advantages of above used method over other?
2. Which surface preparation/coating method will you select to improve surface properties i.e. wear resistance and fatigue life of a spur gear used in automobile gear box?
3. Write a case study on coatings/surface modification of any engineering components. (Refer any research paper).

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