

The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Mechanical Engineering



Study Programme : Bachelor of Science Honours in Engineering
Name of the Examination : Final Examination
Course Code and Title : DMX6303 Nano Technology
Academic Year : 2024/25
Date : 07th February 2026
Time : 0930-1230h
Duration : 3 hours

General instructions

1. Answer all questions.
2. This question paper consists of **Five (5)** questions in **Three (3)** pages.
3. Answer for each question should commence from a new page.
4. Answers should be in clear handwriting.
5. Do not use red color pen for answering questions.

Question 01: Fundamentals and Concerns of Nanotechnology (20 marks)

- a. Identify **three key milestones** in the historical development of nanotechnology and briefly explain their significance. (04 marks)
- b. Explain the **classification of nanomaterials based on their dimensionality (0-D, 1-D, 2-D, and 3-D)**, using suitable diagrams and relevant examples. (08 marks)
- c. Nanotechnology is considered both an opportunity and a concern. (08 marks)
Discuss three technological benefits and three potential environmental or health concerns associated with nanomaterials.

Question 02: Unique Properties of Nanomaterials (20 marks)

- a. Explain why the **crystalline state** is energetically favorable in solids and how atomic arrangement contributes to material stability. (04 marks)
- b. Explain the types of defects in crystalline materials. How does reducing the grain size to the nanoscale affect the role of these defects? Use sketches where appropriate. (08 marks)

- c. Examine how nanoscale dimensions affect **any three** of the following (08 marks) properties:
- Elastic
 - Electrical
 - Magnetic
 - Optical
 - Thermal

Explain the governing mechanisms with suitable examples.

Question 03: Quantum Theory (20 marks)

- a. Define **wave-particle duality** and illustrate the concept using a (03 marks) nanoscale-related example from nanoscale science or nanotechnology.
- b. Explain the concept of **energy quantization** and discuss its (04 marks) importance in nanoscale systems.
- c. Discuss the influence of **quantum effects** on the behavior of (06 marks) nanostructures, nanoparticles, and nanoclusters
- d. Explain how developments in **quantum-based nanotechnology** can (07 marks) lead to the creation of advanced nanodevices. Briefly discuss their potential future applications.

Question 04: Synthesis Routes of Nanomaterials (20 marks)

- a. Briefly explain the **top-down** and **bottom-up** approaches used in (03 marks) nanomaterials synthesis. Use simple diagram to show the difference between the two approaches.
- b. Classify the following fabrication techniques as either **top-down or** (03 marks) **bottom-up** approaches:
- i. Sputtering
 - ii. Mechanical milling
 - iii. Molecular Beam Epitaxy (MBE)
 - iv. Photolithography
 - v. Sol-gel method
 - vi. Chemical Vapor Deposition (CVD)
- c. Select **one top-down** and **one bottom-up** synthesis method from part (07 marks) (b) and describe their process **steps, main features, and relevant reactions**, where applicable.
- d. Explain how **sintering mechanisms** assist in the densification of (07 marks) nanopowders, with reference to **green density** and consolidation behavior.

Question 05: Tools and Techniques for Characterization of Nanomaterials (20 marks)

- a. Briefly Explain the importance of **characterization techniques** in the study and application of nanomaterials. (02 marks)
- b. Compare Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) with respect to: (08 marks)
 - Working principle
 - Resolution
 - Sample preparation
 - Applications in nanomaterial analysis
- c. Discuss the role of **advanced and emerging characterization tools** in the future development of nanotechnology, with particular emphasis on their impact on research advancements and industrial applications. (10 marks)

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