The Open University of Sri Lanka
Faculty of Engineering Technology

042

Study Programme	:	Bachelor of Technology Honours in Engineering
Name of the Examination	:	Final Examination
Course Code and Title	:	**Nano Technology** DMX 6303
Academic Year	:	2021/22
Date	:	25th February 2023
Time	:	0930-1230hrs
Duration	:	**3 hours**

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Six (6)** questions in **Three (3)** pages.
3. Answer any **Five (5)** questions.
4. All questions carry equal marks.
5. Answer for each question should commence from a new page.
6. This is a Closed Book Test (CBT).
7. Answers should be in clear handwriting.

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(1) (a) What is nanotechnology, and how does it differ from other fields of science and engineering?

(5 marks)

(b) Discuss the key principles and characteristics of nanotechnology and explain how they enable researchers to manipulate materials on an atomic or molecular scale.

(5 marks)

(c) What are the microstructural features of nanocrystalline materials, and how do they affect the mechanical, electrical, and other properties of these materials?

(5 marks)

(d) Discuss the role of grain boundaries, dislocations, and other defects in nanocrystalline materials with suitable diagrams.

(5 marks)

(2) (a) What is the basic postulate of quantum theory, and how does it differ from classical mechanics?

(5 marks)

(b) Discuss the key principles of quantum mechanics, including wave-particle duality, uncertainty principle, and superposition, and explain how they relate to experimental observations.

(5 marks)

(c) Explain the impact of quantum confinement, surface effects, and size-dependent energy levels on the electronic, optical, and mechanical properties of nanomaterials.

(5 marks)

(d) Discuss techniques for characterizing the quantum properties of nanomaterials, such as spectroscopy and microscopy, and their limitations.

(5 marks)

(3) (a) What are the different synthesis routes for producing nanomaterials, and how do they affect the properties of the resulting materials?

(4 marks)

(b) Discuss the challenges associated with scaling up production for practical use by considering the applications of nanomaterials produced through different synthesis routes with neat sketches.

(8 marks)

(c) Explain the different consolidation techniques for producing dense and uniform bulk materials from nanopowders, including sintering, spark plasma sintering, and hot isostatic pressing with neat sketches.

(8 marks)

~~(4)~~ (a) What is X-ray diffraction (XRD) nanolithography, and briefly explain, how can it be used to fabricate nanoscale patterns and structures with neat sketches.

(5 marks)

(b) Discuss the underlying principles of XRD nanolithography, including the interaction of X-rays with matter and the role of diffraction in creating periodic patterns.

(5 marks)

(c) What is a scanning electron microscope (SEM) and explain it briefly with neat sketches showing how it works.

(5 marks)

(d) Discuss the different modes of SEM imaging, including secondary electron imaging, backscattered electron imaging, and energy-dispersive X-ray spectroscopy.

(5 marks)

(5) (a) What are carbon nanotubes, and briefly explain their unique properties and potential applications?

(5 marks)

(b) Discuss the different synthesis methods for producing carbon nanotubes, such as chemical vapor deposition and arc discharge, and explain the advantages and limitations of each method.

(5 marks)

(c) What are the potential applications of nanocrystalline zinc oxide and titanium oxide in the field of photocatalysis, and how do their properties influence their photocatalytic performance?

(5 marks)

(d) Discuss the mechanical, electrical, and optical properties of nanocrystalline zinc oxide and titanium oxide, and how they can be tuned through changes in the synthesis conditions.

(5 marks)

(6) (a) What are the potential applications of nanomaterials in various fields, and what are the challenges associated with developing practical nanotechnology-based products?

(5 marks)

(b) How Nano Technology can be effectively used in Sri Lanka for the development of the country?

- Identify the potential areas that can be apply the Nano technology.
- Suggest possible approaches for the use of technology.
- How it is effective for Sri Lankan economy.

(15 marks)